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FRACTURES OF THE MANDIBLE

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For the past fifteen years I have either treated or supervised the treatment of approximately 2,000 fractured mandibles at the 20th General Hospital in India; Crile General Hospital in Cleveland, Ohio; Jackson Memorial Hospital in Miami, Florida; and the Veterans Administration and Doctor's Hospitals in Coral Gables, Florida. At the teaching hospital, Jackson Memorial, where a resident-training program is in effect, it has been possible to try new methods of treatment in the hope of reducing the length of hospitalization and disability.

In this article attention will be focused upon correct diagnosis, careful treatment planning, and the various aspects of treatment of fractures of the mandible.

The patients in the teaching hospital are of both private and staff or clinic status in the ratio of 1 to 20. This means that the oral surgeon in charge of the program and his staff must give freely of their time to charity.

TREATMENT PLAN

In the care of patients with jawbone fractures, one soon realizes the complications which may occur and learns to weigh the potential benefits against the risks. Fractures may result from fights, industrial accidents, automobile accidents, falls, or gunshot. The patient may have brain damage or injury to another part of the body which necessitates close cooperation between the oral surgeon and another specialist.

There may be extensive fractures of the jawbones, with or without facial lacerations or intraoral communication. Wounds are classified as infected or "clean." In accidental injuries open wounds are not uncommon, and they are

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invariably contaminated. Certain bacteria enter the wound at the time of injury, and others enter during emergency care before the patient is taken to a hospital.

The administration of an adequate antibiotic dosage has proved capable of bridging the gap between the injury and the definitive care. In open wounds 1,500 units of T.A.T. is given when there are no contraindications.

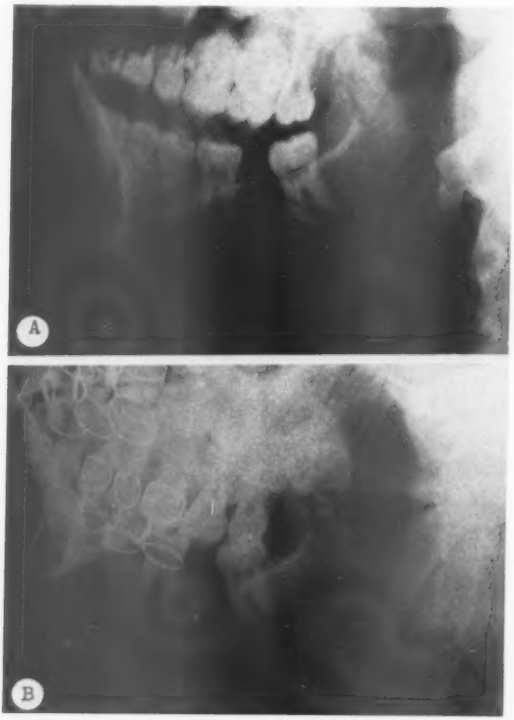


Fig. 1.—Simple fractures reduced by interdental wiring and elastic traction.

A, Roentgenogram reveals fracture at the angle of the mandible with no fragment displacement.

B, Postreduction roentgenogram demonstrates interdental wires and teeth in occlusion. The wires were removed at the end of the third week; convalesence was uneventful.

X-ray Survey.—An adequate x-ray examination is of prime importance. Reduction of fractures should be delayed until satisfactory roentgenograms are obtained. From a legal point of view, this is of great importance.

Dentition.—When teeth are present, it is essential to determine what the normal occlusion was previous to the injury. For a good result, the occlusion of the teeth must be as near normal as possible at the end of the treatment.

If the patient was wearing dentures at the time of the accident, every effort is made to locate the dentures, or parts of them if they have been broken.

When necessary, the dentures can be repaired or adjusted and used as splints to maintain the fractured parts in alignment.

METHOD OF TREATMENT

Jaw fractures may be treated by a number of methods, including interdental wiring, application of arch bars, application of splints, circumferential wiring, external fixation, and open reduction. Which shall it be? The simplest, most easily applied method of reduction has often proved to be the best method. Surgical aims are to refuse any procedure which could add to a disability.

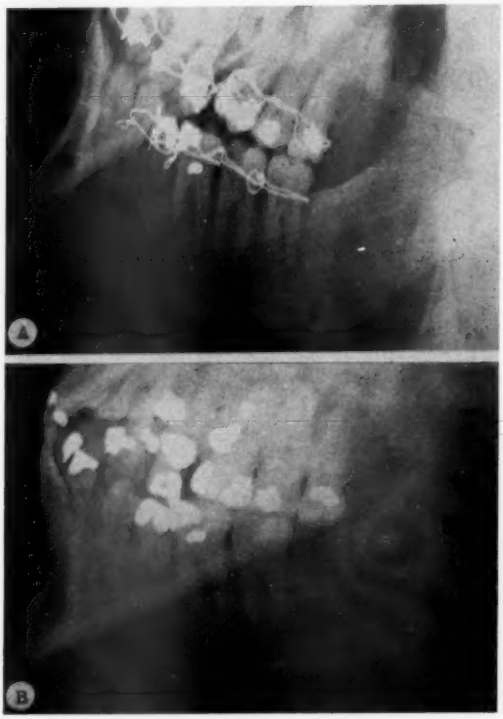


Fig. 2.—Fracture at the angle of the mandible with third molar in the line of fracture.
A, Roentgenogram made after reduction of the fractures by interdental wiring. The third molar was retained until fibrous union had taken place.
B, Postreduction roentgenogram made after the third molar was removed. Convalescence was uneventful, and the patient was discharged at the end of the fourth week.

Interdental Wiring.—Interdental wiring with 25 gauge stainless steel, the eyelet method, or continuous wiring, Stout method, is very satisfactory when a good dentition permits the teeth of the maxilla and the mandible to be brought into occlusion with elastic traction.

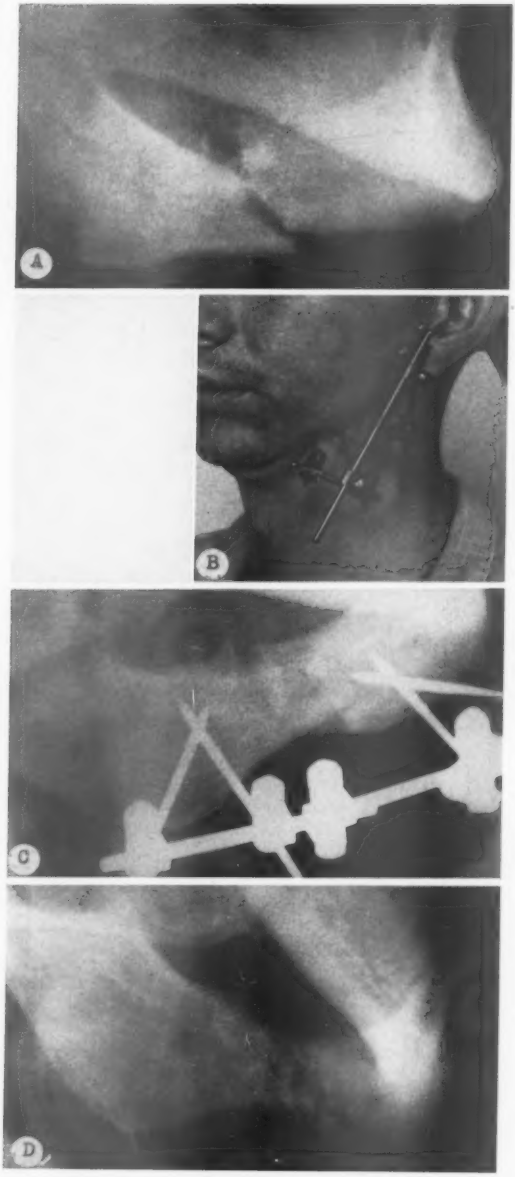


Fig. 3.—Fracture of edentulous mandible reduced by skeletal pin fixation.
A, Roentgenogram demonstrates fracture through body of mandible.
B, Appliance in position.
C, Roentgenogram reveals two pins in each fragment.
D, Postreduction roentgenogram made four weeks after the pins were inserted and immediately after removal; the result was satisfactory.

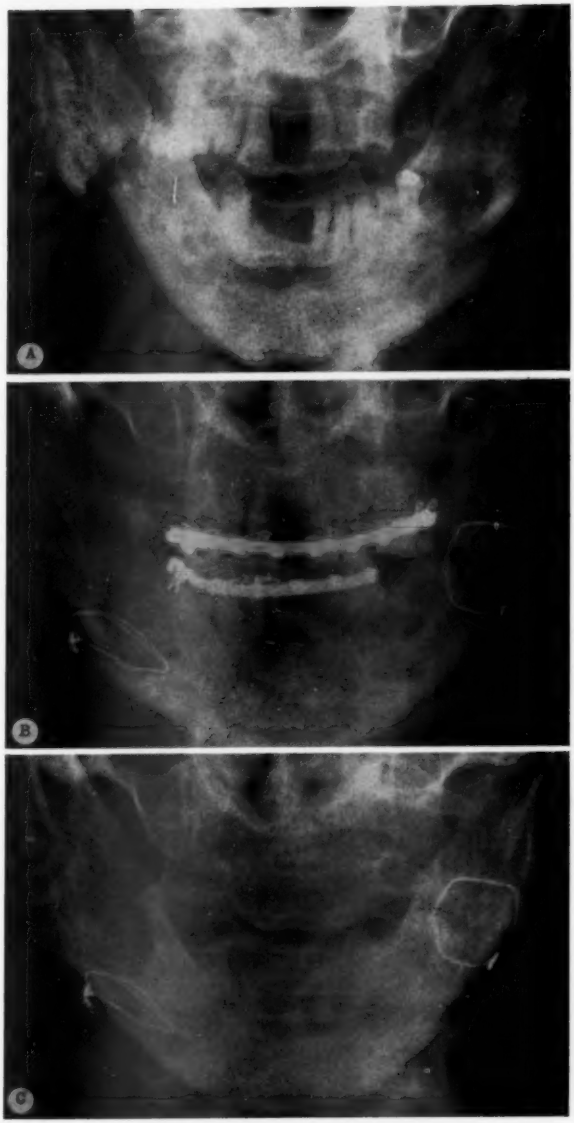


Fig. 4.—Bilateral mandibular fractures reduced by the open reduction method.

A, Roentgenogram demonstrates fractures at the angle on both sides of the mandible with displacement.

B, Postreduction roentgenogram made after the fragments were approximated and held in proper position by transosseous wiring. Arch bars were applied to the few remaining teeth and made firm by interdental wiring. Elastic traction was used to bring the teeth into occlusion.

C, Roentgenogram made four years after discharge. The remaining teeth had been removed, and the patient was wearing full dentures.

Application of Arch Bars.—Arch bars may be used when there is a full complement of teeth, or they may be used to bridge spaces when teeth are missing. The bars are attached to the teeth with 25 gauge wire, and the teeth are brought into occlusion with elastic traction.

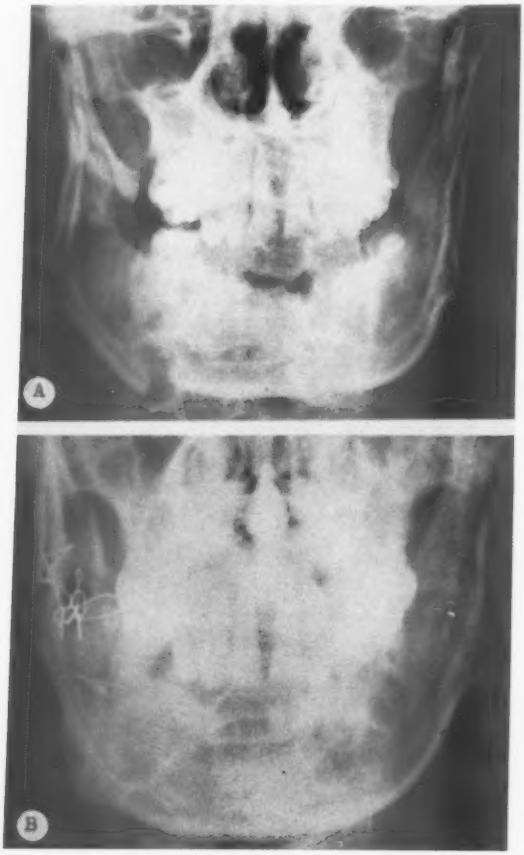


Fig. 5.—Multiple fractures reduced by open reduction method.
A, Roentgenogram discloses multiple fractures at the angle and ascending ramus.
B, Postreduction roentgenogram shows multiple transosseous wire loops. The fractured fragments remained in good position, and the patient was discharged during the fifth week.

Application of Splints.—Acrylic or cast-metal splints are used in many service hospitals where laboratory facilities are available. There is a particular advantage in using cast splints to reduce fractures in children.

Circumferential Wiring.—Circumferential wiring is used to maintain alignment of fractured parts in the edentulous patient. The denture is used as a splint and is held in place with stainless steel wire.

Fig. 6.—Bilateral fractures reduced by circumferential wiring, with the patient's dentures serving as a splint.

A, Roentgenogram reveals bilateral mandibular fractures with displacement.

B, Postreduction roentgenogram shows the fragments in good alignment. The circumferential wires held the acrylic dentures snugly to the mandible.

C, Roentgenogram made after the appliance was removed. The denture was cleaned and polished, and the patient was wearing it satisfactorily when discharged during the fifth week.

External Fixation.—External fixation has proved successful in edentulous mandibles.

Open Reduction.—Preoperatively, a physical examination is performed to determine the fitness of the patient. Then instruments and anesthetic are selected. Preoperative sedation with Demerol combined with scopolamine in proper dosage is practical in most cases if given one hour before the scheduled operation.

Induction of anesthesia with intravenous Pentothal sodium is rapid and easy for the patient; this is followed by administration of the anesthetic of choice through a nasotracheal tube. Temporary tracheostomy for prophylactic

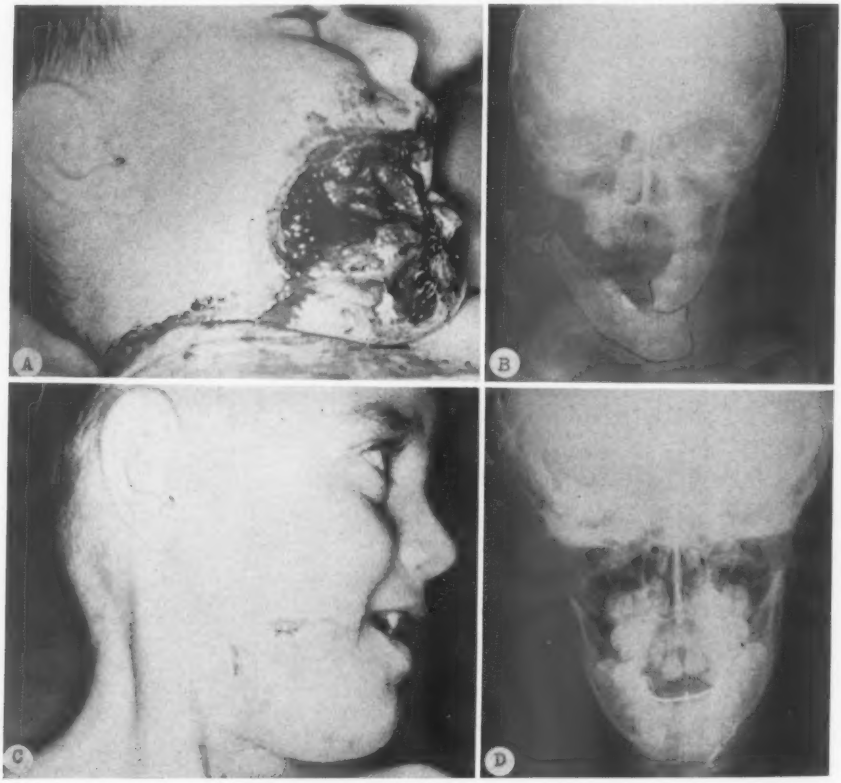


Fig. 7.—Fractures of the mandible in a 10-year-old child. These fractures were reduced with acrylic splint and circumferential wiring.

A, Extensive lacerations of the face occurred when the child was thrown from a horse and hurled against a wire fence.

B, Roentgenogram demonstrates fracture at the symphysis with displacement. The condyle, which was torn loose, was exposed in the facial wound.

C, The facial wound healed.

D, Postreduction roentgenogram reveals the fragments at the symphysis in good alignment. This was made possible by applying an acrylic splint to the mandibular teeth. Circumferential wiring was applied to hold the splint in contact with the teeth. The condyle was removed through the facial wound. Two years after discharge, the patient had no difficulty in chewing, and mandibular function was nearly normal.

reasons is advisable when great swelling about the oral cavity is seen or anticipated. This procedure is warranted if the teeth are brought into occlusion and maintained there before the patient recovers completely from the anesthetic.

Fig. 8.—Mandible fractured by rifle bullet.

A, Gross swelling of face with ecchymosis around the eye. The bullet entered below the ear and struck the mandible.

B, Roentgenogram reveals multiple fractures at the angle. The bullet (25 caliber) was found in the temporal region.

C, Postreduction roentgenogram shows the teeth in occlusion with interdental wiring. The bullet was removed, and convalescence was uneventful. The mandible was immobilized for four weeks.

The operation should be carefully planned, step by step, and done with the minimum of delay. Proper instruments and adequate assistants contribute greatly to a successful procedure. The patient is accompanied to the recovery room by the assistant, and postoperative orders are written immediately.

Postoperative care: If a tracheostomy was done, a strong throat suction with a rubber catheter attachment is placed at the bedside following the operation, and orders as to its use are written. For postoperative pain, Demerol in adequate dosage will keep the patient comfortable. Antibiotic therapy is continued while the patient is in the hospital.

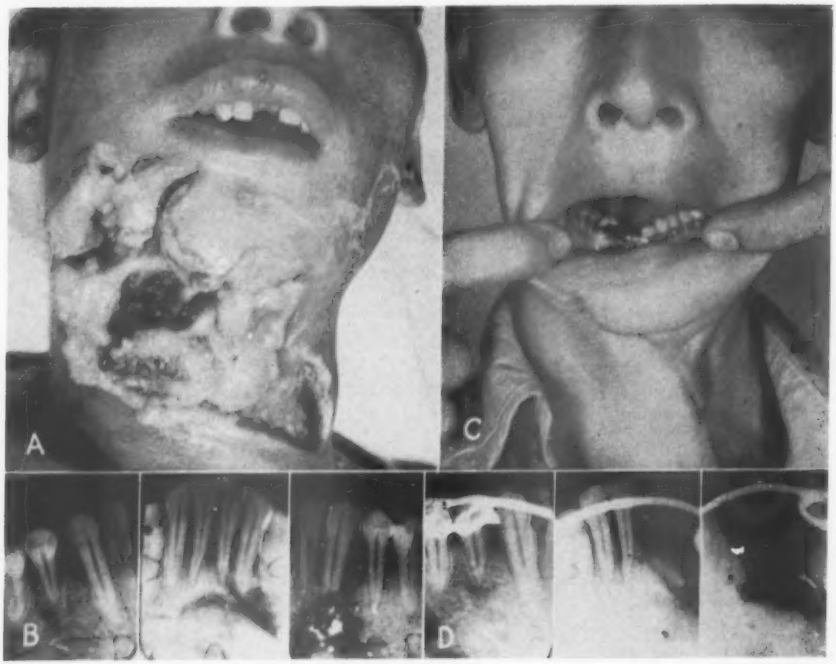


Fig. 9.—Metal splint applied to mandibular teeth.
A, Gunshot wound several days old and infested with maggots.
B, Roentgenogram reveals mandible fracture, destroyed teeth, and metal fragments.
C, Cast-metal splint attached to the mandibular teeth by interdental wires.
D, Postreduction roentgenogram made after the teeth were removed and the splint was applied.

(From Cook, T. J.: *J. Oral Surg.* 9: 4, 1951.)

Nutrition: Swallowing may be difficult for the first twenty-four hours, since it is a new experience for the patient to take liquids and swallow with the teeth held firmly in occlusion. Concentrated formula feedings of liquefied foods prepared in a Waring Blendor with supplementary vitamins may be used. For the average patient, a diet of 3,000 calories in 2,400 c.c. over a twenty-four-hour period, 300 to 400 c.c. every three hours, has proved satisfactory. Oral hygiene is essential, and the patient is instructed as to the method of choice.

ORDERS

When a patient is on the oral surgery service in a hospital, the oral surgery resident is responsible for writing the orders on the patient's chart. If the

patient is admitted on another service and the oral surgeon is participating in the treatment, then one person should have the responsibility of writing all orders in order to avoid conflict. Progress notes are made by everyone who sees the patient.

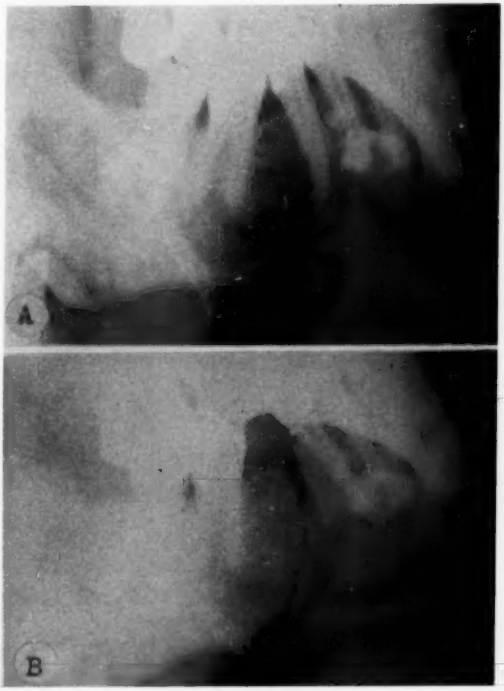


Fig. 10.—Osteomyelitis following removal of a tooth in the line of fracture.

A, Roentgenogram reveals a fracture in the body of the mandible extending into the premolar area. Although the patient went to a hospital no treatment was given.

B, Two weeks after the injury the second premolar was removed by the patient's dentist, and osteomyelitis developed. Following incision and drainage, cultures were made and antibiotic therapy was given. Immobilization of the mandible was achieved by interdental wiring and elastic traction for six weeks.

COMPLICATIONS

Osteomyelitis may occur as the result of local injury which permits the access of pyogenic organisms or permits their development. The periosteum becomes edematous and infiltrated with pus, and the surrounding soft parts may become the seat of intense inflammatory change.

Since the advent of antibiotics, the incidence of osteomyelitis in fractured mandibles that are treated early has decreased greatly. It is seen in patients who delayed applying for treatment or in whom teeth were removed without adequate antibiotic therapy. Malocclusion is the result of poor management of the fractured mandible or of the patient's failure to cooperate.

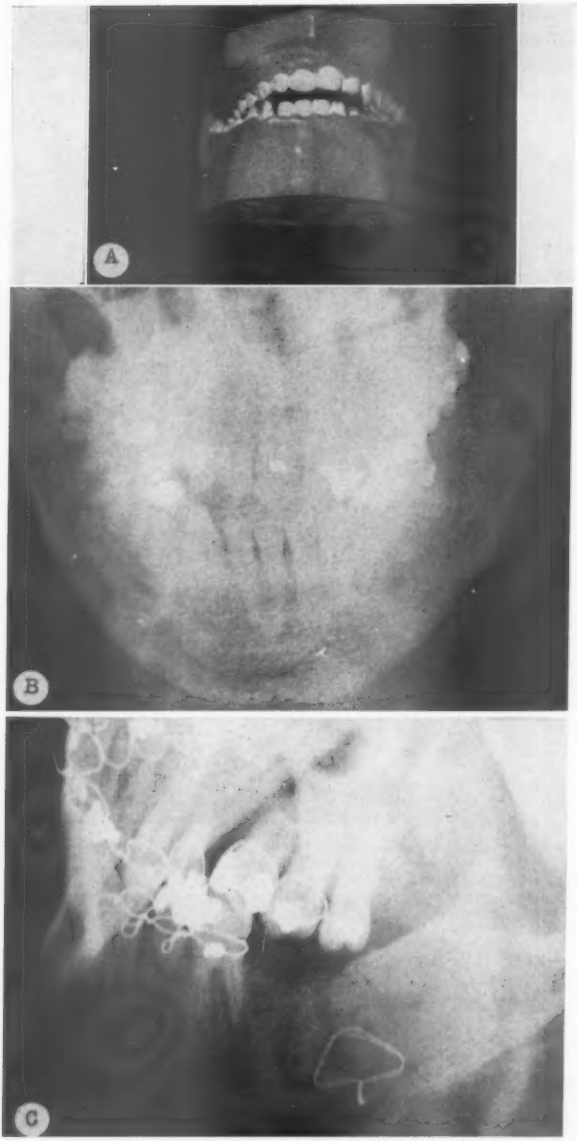


Fig. 11.—Malunion treated by open reduction.

A, Plaster casts reveal an open-bite.

B, Roentgenogram demonstrates an old fracture site at the angle of the mandible.

C, Roentgenogram shows the segment approximated and held in position by transosseous wiring. At the time of operation, the superior portion of the mandible was found to be healed but there was space at the inferior border which contained fibrous tissue. The fragments were separated, cleansed of fibrous tissue, and approximated. Interdental wires were applied, and the teeth were brought into proper occlusion with elastic traction.

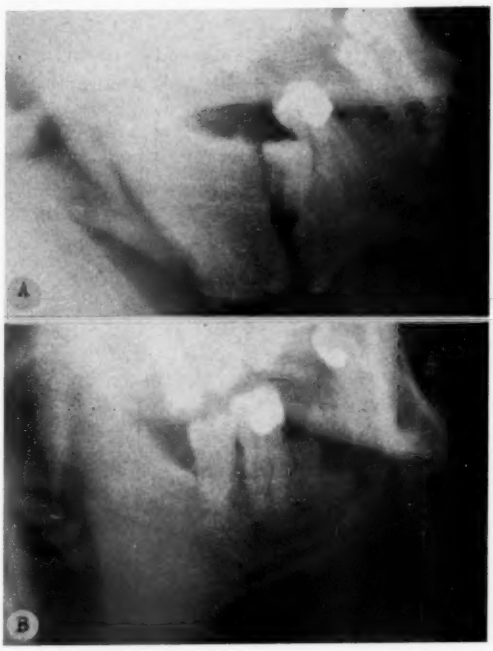


Fig. 12.—Third molar erupts after fracture.

A, Roentgenogram reveals a fracture at the angle of the mandible, posterior to an unerupted third molar, in a 23-year-old man. The fracture was reduced by interdental wiring and elastic traction.

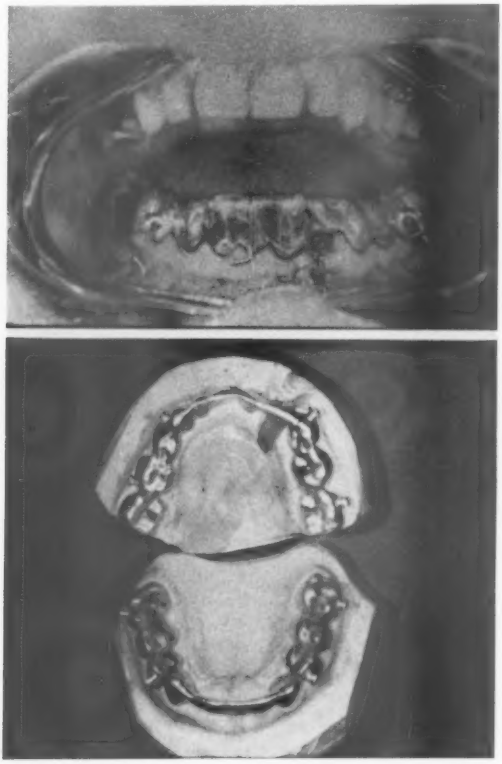
B, Roentgenogram made two years after the patient was discharged reveals that the third molar erupted into normal position without any special treatment.

Fig. 13.—Barton bandage. Photograph of patient who had multiple mandibular fractures. A tracheostomy was done because of extensive swelling which made breathing difficult. The Barton bandage made the patient comfortable until fractures could be reduced by the closed method of interdental wiring.

COMMENTS

In this series of over 2,000 cases the average period of immobilization of the mandible was four weeks in patients who were seen early.

A.



B.

Fig. 14.—Appliances used in children.

A, Cast-silver appliance used to reduce a fractured mandible in 12-year-old boy. The appliance was held in place by circumferential wiring. Individual wires were placed on the maxillary teeth in order to bring the teeth into occlusion by elastic traction.

B, Cast-silver splints are fitted to a corrected plaster model before insertion. Extensions are used on the castings to hold the elastic bands.

Correct diagnosis, careful treatment planning, correct treatment, a cooperative patient, and careful postoperative observation are essential to the successful treatment of the fractured mandible.

JACKSON MEMORIAL HOSPITAL

SURGICAL TREATMENT OF MULTIPLE FACIAL FRACTURES

Report of Three Cases

Irving S. Levin, B.S., D.D.S., Johnstown, Pa.

MULTIPLE facial fractures, though seen less frequently than simple mandibular fractures, must be correctly diagnosed and properly treated. Improper treatment or lack of treatment due to an incomplete roentgenographic survey may produce a facial deformity which may affect the personality of the patient.

The three cases discussed in this article are cases in which, because of the complexity of the injury, some of the fractures might easily have been overlooked, especially since they were caused by a simple and obvious injury. Diagnosis in each case was made on the basis of an extensive roentgenographic study as well as thorough clinical evaluation.

These cases had remained untreated for periods of from three days to three weeks, thus necessitating modifications of standard treatment in order for satisfactory cosmetic results to be obtained. It will be shown that frequently it is possible to reduce multiple fractures by the use of a single force correctly applied. A study of the basic forces needed for reduction is necessary prior to any operative procedure. Extremely close cooperation between the various medical specialties is also imperative, as will be shown.

CASE REPORTS

CASE 1.—J. B., a 23-year-old white man, was admitted to the hospital at Parks Air Force Base, California, on May 3, 1956, with a diagnosis of simple fracture of the mandible. The patient had been injured in an automobile accident on April 14 and was still in acute distress.

Clinical Examination.—A compound fracture of the symphysis of the mandible was seen, with the bony fragment protruding from the submental region. Circumferential wires attached to an acrylic base plate were in position (Figs. 1 and 2). The forehead and jaws were bound with a Barton head bandage, under which a large decubital ulcer was found. The maxillary teeth were replaced by a complete denture in good condition.

Laboratory findings were within normal limits, and there was no evidence of traumatic injury elsewhere in the body. Medical clearance was obtained from the department of internal medicine.

Psychologically, the patient was in a state of extreme anxiety. Consultations with the neurosurgery and psychiatry departments eliminated the possibility of cerebral damage; therefore, the psychic state was attributed to the effect of the physical injury.

Routine radiographic examination consisted of (1) right and left lateral jaw films, (2) a posteroanterior film of the mandible, (3) a posteroanterior Waters' position film,

(4) a posteroanterior modified Waters' position film, (5) a stereo Waters' position film, (6) a submentovertex view, and (7) lateral head plates. Occlusal and periapical films were also taken.

The following fractures were noted: (1) severely comminuted fracture of the symphysis of the mandible, (2) fracture of the left mandible at the angle, (3) severely comminuted fractures of the right and left maxillae and zygomas.

Fig. 1. Fig. 2.

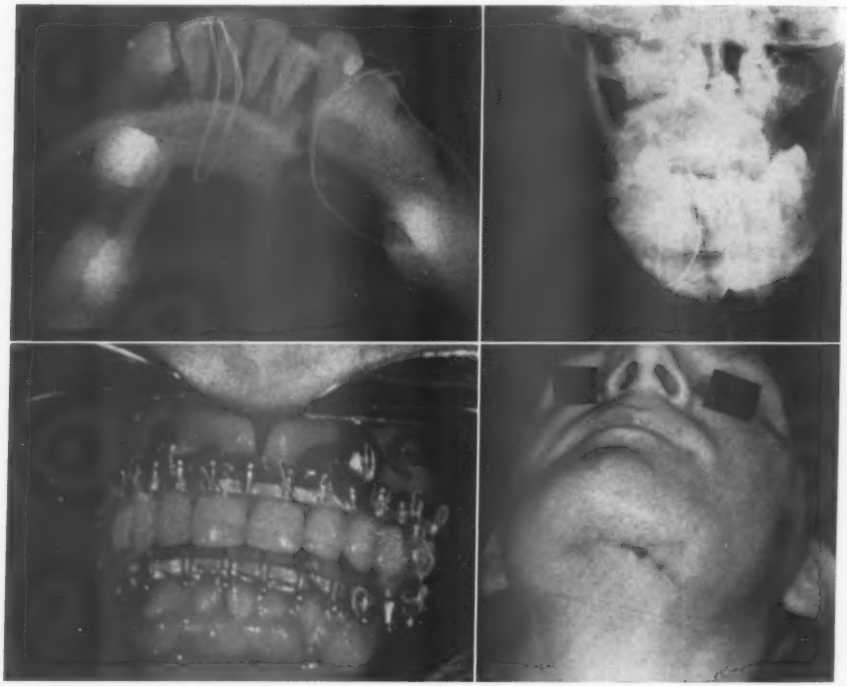


Fig. 3. Fig. 4.

Figs. 1 and 2.—Case 1. Roentgenograms taken on admission with circumferential wires still in position.

Fig. 3.—Case 1. Postoperative films showing maxillary appliance held in position with stainless steel screws.

Fig. 4.—Case 1. Photograph of wound two weeks postoperatively.

Operation.—All appliances, including the circumferential wires, were removed. The patient was placed on supportive therapy for the following week, and on May 8, 1956, he was considered by the medical and psychiatry departments to be ready for surgery.

A Winter arch bar was attached to the maxillary denture; this was done by drilling interproximal holes and inserting 0.027 gauge wire between the teeth and around the arch bar. Two holes were placed in the flange of the denture in the area of the canine eminence.

The patient was anesthetized with Pentothal sodium with nitrous oxide-oxygen endotracheal intubation. An incision was made through the laceration in the submental region, extending approximately 2 cm. at each end of the laceration. Thorough débridement of the wound was performed. The mandibular fragments were approached by blunt dissection, and all comminuted fragments which were unattached to periosteum were

removed. The remaining large fragments were wired by the transosseus method after having been freed with a broad osteotome. The wound was repaired in layers and closed with 00000 black silk. A Winter arch bar was contoured to the lower teeth and wired into position.

A bilateral incision was then made in the maxillary mucobuccal fold from the cuspids posteriorly to the second molar area. Both maxillary sinuses were opened via the Caldwell-Luc approach, and all comminuted bone fragments were removed. The floors of both orbits were elevated into position. Healing of the malar bones had progressed to a point where any manipulation was impossible without severe trauma. The incisions were closed with 000 gut sutures.

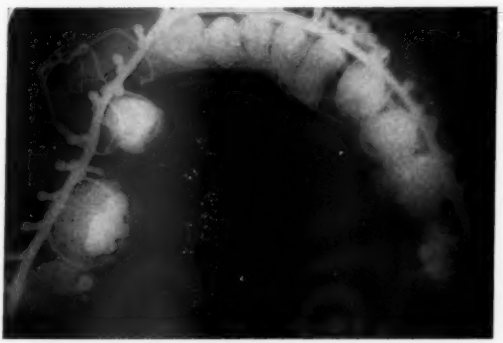


Fig. 5.—Case 1. Postoperative roentgenogram.

Fig. 6.—Case 1. Photograph of patient two months postoperatively.

The maxillary denture was placed in position and, with the holes in the denture flange serving as guides, holes were drilled in the canine eminence of the maxilla. Stainless steel screws, 1½ inches long, were inserted through the flange into the bone to maintain the maxillary appliance in position. Intermaxillary elastics were placed to connect the arch bar on the denture with the arch bar on the permanent dentition (Fig. 3).

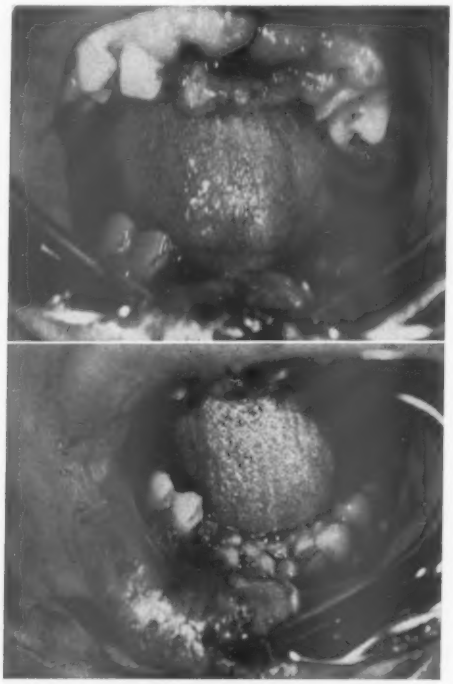
Healing progressed well (Fig. 4). The patient's mental attitude improved considerably. During the next nine weeks strict oral hygiene was maintained. Routine roentgenograms were taken to check the alignment of the fractures (Fig. 5). On July 17, all appliances

were removed. A new denture was constructed by the prosthetic department, and on October 5, following a convalescent leave, the patient was discharged from the hospital in good condition (Fig. 6).

CASE 2.—R. P., a 19-year-old white male patient, was admitted to the hospital on April 30, 1956, after having been involved in an automobile accident on April 27.

Clinical Examination.—The patient was in a state of shock. Blood studies and urinalysis were essentially negative. There were massive lacerations of the lips and palate. Numerous fragments of bone were seen to protrude from the anterior maxilla and mandible (Fig. 7, *A* and *B*). There were tenderness, swelling, and deformity over the right medial malleolus.

A.



B.

Fig. 7.—Case 2. Preoperative photographs showing comminuted fragments.

Roentgenographic survey revealed multiple compound, comminuted fractures of the maxilla, palatal bones, and infraorbital margins. Both malar bones were depressed. There was a simple fracture of the right medial malleolus.

Operation.—A plaster headcap with a steel framework was constructed. The patient was anesthetized with Pentothal sodium with nitrous oxide-oxygen endotracheal intubation. The lacerations were thoroughly débrided and repaired in layers; 000 chromic gut and 000000 black silk sutures were used.

Incisions were then made in the mucobuccal folds, and both malar bones were elevated to position. Winter arch bars were attached to all remaining maxillary teeth and stainless

steel wire, 27 gauge, was threaded through a No. 18 needle which was placed through the face over the malar prominences. The wires were attached to the headcap and tightened until no further movement of the maxilla could be palpated.

The patient was given 500 c.c. of whole blood and 500 c.c. of plasma during the procedure. He reacted at the completion of the operation and was returned to his room in good condition.

On May 9 an orthopedic surgeon treated the right ankle. This procedure involved open reduction and fixation of the medial malleolus with a bone screw. The patient progressed well following both operations.

All appliances were removed four weeks following the oral surgery procedure (Fig. 8). Roentgenograms showed evidence of good position and alignment of the fragments. The prosthetic department prepared replacements which compensated for the bone loss in the anterior maxilla. The patient's treatment was completed by the orthopedic service, from which he was discharged on October 25.

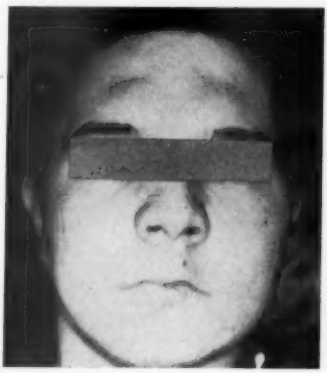


Fig. 8.—Case 2. Photograph of patient four weeks postoperatively.

Fig. 9. Fig. 10.

Fig. 9.—Case 3. Photograph of patient on admission. Note scleral hemorrhage.
Fig. 10.—Case 3. Intraoral view showing malocclusion due mainly to displacement of maxilla.

CASE 3.—A. H., a 23-year-old white man, was admitted to the hospital on May 11 with a diagnosis of fractured radius and fractured mandible following an automobile accident on May 7 (Fig. 9).

Clinical Examination.—The patient was unable to move his mandible in any direction. There was evidence of severe displacement of the left mandible, as seen in Fig. 10. The patient had bilateral periorbital hematomas with infiltration of the hemorrhage into the sclera. There was a noticeable crepitus over the left zygoma in the region of the frontal process. In addition, the patient had a severe Colles' fracture of the right forearm.

Routine blood tests and urinalysis were within normal limits. Consultation with the neurosurgical department revealed no detectable intercranial damage, and the patient was cleared for surgery.

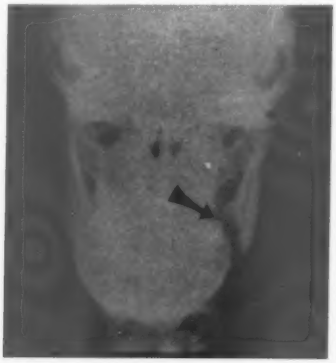


Fig. 11.—Case 3. Preoperative film showing severe displacement of left mandible.

Fig. 12.—Case 3. Postoperative film showing transosseous wiring.

Routine facial studies revealed a severely displaced fracture at the angle of the left mandible (Fig. 11). There were fractures of both maxillae and zygomas. The right maxilla and zygoma were in excellent alignment. The left zygoma was displaced laterally in the region of the zygomaticotemporal suture.

Operation.—On May 15, Winter arch bars were applied to the maxillary and mandibular teeth following induction of Xylocaine 1:100,000 regional anesthesia. Elastic intermaxillary traction was placed and maintained until May 17, at which time the patient was prepared for general surgery.

It was decided that a single force applied to the left zygomaticotemporal suture area would counteract all other forces applied to the fractures of the facial complex.

The patient was anesthetized with Pentothal sodium and endotracheal anesthesia. Open reduction was performed on the left mandible, and the fragments were maintained by the transosseus method (Fig. 12). An incision was then made in the left eyebrow and by blunt dissection, the zygomaticotemporal suture was exposed. The temporal process of the zygoma was displaced laterally and posteriorly. The zygoma was repositioned and wired to the frontal bone with 0.027 gauge wire. The zygoma was held firmly in position by the remaining facial bony complex. The wound was sutured in layers with 000 gut and closed with 000000 black silk (Fig. 13). Healing progressed without complications, and on June 28 all appliances were removed. The patient was discharged on July 3 with a good cosmetic result (Figs. 14 and 15) and good occlusion (Fig. 16).

Fig. 13. Fig. 14. Fig. 15.

Fig. 13.—Case 3. Patient five days postoperatively prior to removal of sutures.
Figs. 14 and 15.—Case 3. Photographs of patient six weeks postoperatively.

Fig. 16.—Case 3. Intraoral view six weeks postoperatively.

CONCLUSION

From the case histories that have been presented, it will be seen that numerous injuries may be overlooked in examination unless a thorough roentgenographic survey is made. In all injuries involving the facial complex,

clinical evaluation alone cannot be relied upon for final diagnosis. The roentgenographic examination is the most valuable single aid in diagnosis of traumatic injuries of the face.

A standard form of treatment in multiple facial injuries is frequently of little value. It is often necessary to combine numerous methods after reviewing the fracture lines and the forces necessary to replace the fragments.

Frequently multiple wiring is found to be unnecessary if the proper force is directed in a critical area so that it accomplishes a multiple purpose, as may be seen in Case 3. Satisfactory results may be obtained by any number of methods of treatment. The decision as to the method of reduction should be made on the basis of the operator's preference and special ability.

A further important consideration is the requirement of close cooperation among all the specialties of the healing arts. This is the basis of sound practice and is not an admission of inability on the part of the oral surgeon.

SUMMARY

1. Three cases of multiple facial fractures have been presented.
2. Modified treatment plans have been presented and discussed.
3. The importance of complete radiographic survey has been stressed.
4. The value of close cooperation with the medical specialties has been reviewed.

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EXODONTIA

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COMPLETE DENTAL CARE OF THE HEMOPHILIAC

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In the past, hemophiliacs have had difficulty in obtaining dental treatment. Surgical procedures posed a particular problem, but even routine dental care was difficult to obtain due to the reluctance of many dentists to treat known hemophiliacs. As a result, many hemophiliacs have badly broken-down dentitions and are frequently troubled with pain, infections, and bleeding in the oral cavity. A dentist faced with a normal patient in an acute stage, be it pain, infection, or bleeding, will understandably be concerned about treatment. When he is faced with the additional difficulty of hemophilia, such concern is compounded.

In this modern age, when dentistry has found means to treat sufferers of cerebral palsy, muscular dystrophy, and other similar diseases, certainly sufferers of hemophilia can be treated with equal success. In order to do so, one must realize that treatment of a hemophiliac is not "routine" treatment. It must be modified and bent to the requirements of the patient. The dentist must be aware of the various problems involved and of the required solution to these problems. Any dentist who is treating a hemophiliac should at all times be in contact with the patient's hematologist and family physician. The dentist should have an idea of the patient's background in all sorts of bleeding episodes and should know what may constitute a bleeding phase. It would certainly be valuable for the dental practitioner to have a fairly good idea of what the present-day term "hemophilia" means, since today we recognize three different types of hemophilia. The dentist should recognize that some dental procedures must be carried out in a hospital, whereas others may be performed in the dental office. The patient must also be made aware that he requires thorough treatment and must be seen regularly, perhaps more often than a

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normal patient. Preventive treatment is much simpler and a great deal easier to perform than involved restorative procedures which create anxiety for both the dentist and the patient. Emergency treatment should be held to a minimum. When we find a hemophiliac who has had the advantages of regular, comprehensive dentistry and who is aware of his dental needs as pertains to oral hygiene, diet, and special requirements, there is little necessity for emergency treatment.

In this paper we will present principles and techniques that we consider necessary in the treatment of hemophiliacs. These principles and techniques are based upon complete dental treatment which has been available to hemophiliacs for a period of approximately five years in the New York area. The hemophiliacs treated, ranging from those with the most severe type of the disease to those just barely affected, have included both children and adults. Approximately 100 persons have been treated.

Hemophilia is a bleeding disorder in which there is a tendency toward prolonged bleeding periods due to an inability of the blood to clot normally. At the present time there are three recognized categories of hemophilia: (1) AHG, a deficiency of antihemophilic globulin; (2) PTC, a deficiency of plasma thromboplastin component; and (3) PTA, a deficiency of plasma thromboplastin antecedent. These categories are detectable only by laboratory test and are of importance to the dental practitioner only because the PTC and PTA hemophilias are relatively milder than the AHG type. The principles and techniques are the same for all categories, although the results may differ according to the variables involved in the problem.

The fact that a hemophiliac differs from a normal patient only in a hematologic sense makes it essential that the dental practitioner be informed as to the degree of severity of the patient's hemophilia. Therefore, before treatment is begun the hemophilic patient should have been thoroughly evaluated by a hematologist as to type of hemophilia, relative degree of severity, response to plasma, and any other pertinent factors. This evaluation should be communicated to the dental practitioner along with an opinion by the hematologist as to whether the patient should be handled in the routine way for a hemophiliac or whether special considerations are involved. There are hemophiliacs who, for unknown reasons, have become unresponsive to blood or plasma. This means that their bleeding tendency is no longer correctible by plasma or blood, as would be that of an average hemophiliac. In such cases one must either defer any traumatic treatment, if the condition is a temporary one, or, if the condition is permanent, modify the treatment so that it will be as atraumatic as possible or merely ameliorative.

Once the dentist is aware of the type and degree of the patient's hemophilia and has received an evaluation by the hematologist, including the hematologist's opinion as to the amount of correction available and the ease with which it may be achieved, he may then proceed with his dental treatment. To do this adequately, the patient's condition must be diagnosed thoroughly; a complete roentgenographic work-up and history are obtained. The history should include the following:

(a) Type of diet: Soft diet? High carbohydrate? Fresh fruits and vegetables?

(b) Oral hygiene and routine home care: Hard brush? How often brushing? When last seen by dentist, and how often seen in last two years?

(c) Previous bleeding episodes generally: Joint bleeding? Soft tissue bleeding? Bleeding due to trauma? Easy to control? Special consideration?

(d) Previous exfoliation routine: When were deciduous teeth lost? Any overretained? Bleeding? How long?

(e) Previous experience with regard to extractions and surgery: Any teeth extracted? Any bleeding? How long? How much plasma necessary? Secondary hemorrhage, etc.?

(f) Past dental experiences: How often treated? What type of treatment?

(g) Patient reaction to dentistry: Simple to treat? Much pain involved? Any other discomfort?

A clinical evaluation is then undertaken, with particular attention given to the number and degree of broken-down teeth. The aim of dentistry here is to retain, if at all possible, all teeth and to restore as many as possible to function. We will often see teeth so badly decayed as to make extraction almost mandatory, but with a little effort these teeth can be treated and restored to function. For this purpose, endodontics will be found to be a valuable adjunct. It has enabled patients to retain many teeth which would have been lost and difficult to replace. An example here would be helpful.

A 9-year-old boy with hemophilia of moderate severity presented with a badly decayed lower left second deciduous molar which had undergone various phases of acute and chronic infection. A fistula was present on the buccal mucosa, and there was pus draining. Examination revealed that there was no permanent successor; therefore, although the prognosis was poor, it was decided to treat the tooth endodontically. The tooth was handled in a fairly routine endodontic fashion following accepted principles of therapy, such as débriding the canals, filing, and medicating, preparing for gutta-percha filling, and then filling the canals. Six months later the area was clinically asymptomatic, no fistula was present, there was no apparent infection, and roentgenographically there were signs of bone deposition in the area of radiolucence. Retaining this tooth for the child enabled him to avoid extraction, hospitalization, plasma, trauma, and the possibility of further damage due to tooth movement.

Having examined and evaluated the hemophilic patient, the dentist should then proceed with treatment where indicated. Routine care should consist of periodontics, operative dentistry, surgery, endodontics, and prosthetics. Of course, in each phase of dentistry there are modifications, and these will be discussed.

PERIODONTICS

The commonly accepted procedures of scaling, curettage, and gingival resection must, of course, be obviated in the case of a hemophiliac. These would

and should institute bleeding which would be difficult to control if only because of the area involved. A personal communication to one of us from a hemophiliac who had vigorous periodontal therapy shows what may result.

> The patient went to a dentist to have his teeth cleaned and scaled without appraising him of the fact that he was a hemophiliac. The dentist scaled, cleaned, and polished the patient's teeth. Some days later, profuse gingival bleeding began. This developed into a descending submandibular hematoma which, because of its size and pressure upon the patient's trachea, almost caused suffocation. Measures were instituted for a tracheotomy but, fortunately, before it was performed the patient responded to therapy.

Therefore, periodontally speaking, treatment must be judicious and relatively atraumatic so as to cause no bleeding. Scaling of the supragingival calculus and careful removal of subgingival calculus with fine scalers and curettes are indicated. Short and frequent visits are better than intensive ones, since the tissue is thus given a chance to shrink as the edema is reduced and the deeper calculus is allowed to become visible.

Grinding of the teeth to obtain a well-balanced occlusion, to reduce wear facets, to reshape abnormal clinical crowns, and for esthetics is a reasonable service. Adjusting the occlusion by grinding to reduce prematurities and to remove any traumatic occlusion is a necessity. The teeth should then be polished with fine rubber wheels and sandpaper disks and finished by going over all surfaces with pumice and a rubber cup.

An evaluation of the patient's diet and discussion of oral hygiene and home care is invaluable. Many patients, because of their poor dental condition, make an inferior selection of foods and, because of their fear of inducing bleeding, hesitate to brush their teeth. A diet should be suggested which is low in carbohydrates, high in protein, and moderate in fats. Any good diet which features fresh fruit, fresh vegetables, grain breads (such as whole wheat or rye), fresh meats, eggs, fruit juices, and milk is usually adequate. Patients should avoid sweets, starchy foods, and soft, gummy foods. Generally speaking, any diet that is consistent with the recommendations of dieticians for persons in normal health is indicated.

Toothbrushing instruction is to be given to all patients and, although different techniques may be used at certain times, brushing must be stressed. In most cases a modified Stillman technique is taught, care being taken to show patients how not to abrade the gingivae. At other times patients may employ a very soft brush, using a powerful random motion. The random motion is often used when the patient finds that he has a marked tendency to bleed.

In cases where there is marked periodontal inflammation and infection, or where spontaneous hemorrhage is apparent, it is sometimes necessary to hospitalize the patient and premedicate with plasma before treatment. In these cases the patient should be handled as a surgical case, especially when one considers the extent of the surface area involved. It would then be possible to curette the subgingival area to remove all irritants with a minimum of risk.

It is imperative that patients in whom calculus tends to be deposited in large quantities over short periods of time be seen frequently and treated so as to avoid the necessity for any involved procedures.

OPERATIVE DENTISTRY

Treatment is somewhat of a problem, since local anesthesia is contraindicated. There are reports in the literature of death resulting from a dental injection in which blood vessels were pierced. For this reason, we have carried out our treatment without local anesthesia and, although it makes for some difficulty, in general there has been no reason to vary the procedure. Of course, obtundents are used, as well as the new local anesthetic sprays, if only for the numbing sensation that the patient feels.

There is a wide variation in the caries rate in hemophiliacs, just as there is in the general public. There are patients in whom decay is rampant, and there are others in whom the mouth is caries immune. Most patients are in the midrange of caries index and, in addition, are affected by all the factors of heredity, environment, home care, diet, and professional treatment, as are normal patients. Many hemophiliacs, however, have very poor dentitions because of ignorance and lack of treatment. In the hope of avoiding bleeding, they eat soft foods, do not brush their teeth, and either avoid dentists or are unable to find one who will treat them. When they are finally seen by a dentist, their mouths present a picture of utter neglect and require extensive treatment. We attempt to retain all teeth which are not cariously exposed, even if the teeth cannot be rebuilt to function, as is frequently the case. The teeth are filled as well as possible, kept smooth and polished, and permitted to remain.

In the matter of fillings, it is suggested that amalgam be used in posterior teeth and anywhere else possible. When interproximal fillings are being prepared for posterior teeth, however, it is suggested that the filling margin end above the gingiva so that matrices can be placed. It is inadvisable to place matrices and wedges subgingivally, as they can produce bleeding. When caries extend subgingivally to any degree, plastic fillings can be placed by the Nealon or "paint-in" method. This method reduces finishing of restoration to a minimum and avoids strips and matrices. In the anterior teeth, plastic or synthetic porcelain fillings are used almost exclusively, keeping away from the gingivae as much as possible.

As a result of their illness, patients are frequently unable to keep appointments on a regular basis. At times it is difficult for them to come for dental treatment, and it may be many months or even a year or more before they can return. For these reasons, prophylactic odontotomy is often practiced to eliminate readily susceptible areas.

In the matter of exfoliation of deciduous teeth, experience indicates that in many hemophiliacs exfoliation occurs over a fairly lengthy period, with much oozing, and as a result it is a trying period for the child and his parents. Often bleeding will continue over a period of two or more weeks, occasionally

with intervals of no bleeding. It is usually best to wait for Nature to cause complete exfoliation. However, if during the course of the exfoliation the patient loses so much blood due to the oozing that it becomes necessary to transfuse, the offending tooth or teeth may be extracted at this time while the patient's hemostatic defect is corrected. To reduce the oozing as the tooth loosens, it has been suggested that any one or a combination of the following be used: ice, pressure, topical application of Adrenalin, sucking teabags, Hot-R-Cold Pak, Oxycel, liquid thrombin applications, or any remedial measure which may be found in the home. These measures are occasionally necessary even after the tooth has dropped out, and may be applied to the raw socket. If the bleeding is severe, transfusion may be necessary for hemostasis.

In many cases deciduous teeth are overretained. Extraction of these teeth is not indicated, for natural exfoliation is less traumatic. If the permanent teeth are in danger of being locked out of occlusion, however, or if it appears that the teeth will be overretained for years, then extraction is indicated and performed as for any extraction in a hemophiliac.

ENDODONTICS

Endodontics not only enables the patient to retain needed teeth but, of equal importance, it makes it possible to avoid extractions in many cases. This is especially important for the hemophiliac whose bleeding tendency is not corrected by the transfusion of plasma or blood. In patients of this type a pulpitis, abscess, or other pulpal pathology would usually mean ameliorative treatment of any sort, customarily large doses of antibiotics to control the infection and more narcotics to control the pain. With endodontic procedures, however, the patient can be made comfortable and even retain the tooth. This has been done with success in patients with refractory hemophilia as well as in those whose bleeding tendency is corrected by plasma, and it is felt that endodontic treatment is a highly recommended procedure.

Due to the fact that we use no local anesthesia, treatment of vital cases is contraindicated. The extreme pain caused by attempts to remove vital pulp without anesthesia would make adequate completion of treatment impossible. A further contraindication is the fear of causing bleeding due to the removal of vital tissue. For this reason, we have attempted to treat only nonvital cases where we will not be concerned with sensitive or bleeding pulp tissue. In cases in which teeth are exposed and tissue is vital, the tooth may be treated with pulp-capping procedures or carried along for one year or more by means of zinc oxide-eugenol dressings, which are changed when necessary, until the tissue becomes nonvital.

At that time, when the tissue is nonvital, treatment is instituted. Care is taken not to instrument past the apex as this may cause bleeding which is difficult to control and which makes it impossible to obtain a dry canal for filling purposes. It is possible to cause bleeding in the apical tissue so that when the canal is sealed the bleeding will back up and cause an intraosseous

hematoma or worse. This, of course, is an extreme result and plasma would probably be required for the control of such bleeding, but the chances of this type of bleeding occurring are remote. To date, although only a few hemophilic patients have been treated endodontically, the results have been more than satisfactory and we believe that this type of treatment holds great promise.

PROSTHETICS

There are a number of hemophiliacs wearing removal appliances. Most of them have had teeth removed before they were seen by us. The previous extractions were done with varying degrees of success. In some cases, after the patients have had some teeth extracted, we have constructed removable appliances which are made in a routine fashion. In one case, however, some unorthodox procedures were instituted. The patient was refractive to plasma and therefore the bleeding tendency was uncorrectible; this made extractions highly dangerous. The patient had two retained roots in the maxilla and a number of jagged lower anterior stumps. The retained roots and jagged stumps were reduced to the gingival level or slightly below. A full upper denture was constructed against a lower partial denture which utilized the few remaining teeth. The prosthesis was far from orthodox, as was the patient. The prosthesis has been worn for over a year with acceptable results, and the patient is quite pleased at having teeth again.

EXTRACTIONS

In the past, dental extractions for the hemophiliac were fraught with dangers. The literature abounds with reports listing prolonged hemorrhage, resulting anemia, severe pain and discomfort, loss of weight, and even death as results of a single extraction. Several factors which may have caused these difficulties become evident as the cases are studied. Among them are lack of sufficient preoperative administration of plasma, some elective oral surgical procedure, too radical a form of surgery, removal of too many teeth at one time or removal of teeth in widely separated areas, failure to prepare adequate means for control of local hemostasis, poor case selection, and behavior problems. The present goal, which has been achieved, is to make dental extractions for the hemophiliac not only possible but routine.

In order to completely avoid, or at least to minimize, some of the aforementioned problems, certain essential restrictions have been imposed in fashioning a surgical technique. It was decided that not more than two teeth should be extracted and that these should be adjoining or at least in the same quadrant of the jaw. This simplifies the surgeon's task of applying pressure to the area, insertion of hemostatics into the sockets, and obtaining fixation and immobilization of the injured parts.

In the matter of case selection, only those patients who were cleared as good risks by the hematologist were chosen as candidates for surgery. The minimal laboratory procedures undertaken to determine a patient's eligibility

are complete blood count, complete blood typing with screening for isosensitization, prothrombin time, coagulation time, and prothrombin consumption. In addition, each patient is identified as to the type of hemophilia present and an in vitro plasma responsiveness determination is made.

If the hematologist determined that the patient was incorrectible, or in any other way physically unfit, he would advise that the extraction not be performed. The dentist would recommend surgery only for those patients in whom the procedure was necessary and in whom no conservative treatment was feasible. Some of the conditions included in this category were acute alveolar abscesses; overretained deciduous teeth locking permanent successors out of the line of occlusion; jagged, broken-down carious teeth which were abrading gingiva, tongue, or cheek; cariously exposed teeth not suitable for endodontic therapy and exhibiting a severe pulpitis; and other accidental traumatic injuries to the mouth or lips.

The technique was designed with two goals in mind—(1) to minimize hemorrhage and thus to limit the amount of plasma necessary to control it and (2) to shorten the hospitalization time. Recovery periods in the past have ranged from two to six weeks, and in these cases massive or prolonged hemorrhage has resulted. Poor local hemostatic measures were employed, and there are recorded cases in which the administration of anywhere from 200 to 300 units of plasma was required before recovery. These patients sustained varying amounts of anemia, general debility, appetite and weight loss, and inordinate loss of earning power or schooling. Earlier methods relied upon large or clumsy local pressure means; one method (the "rubber band technique) can result in days or even weeks of painful manipulation and usually ends in hemorrhage nonetheless.

The technique for the extraction of teeth in the hemophilic patient is modified by the restrictions and goals previously mentioned.

The patient is admitted to the hospital on the day before surgery. He is given a careful physical examination, and the necessary hematologic work-up is performed. A dental roentgenographic survey and a clinical examination are completed. The following morning preoperative medication and plasma are administered, correction tests are performed, and if everything is satisfactory the extractions are then undertaken.

A team of two dentists proceeds as follows: Local anesthesia is administered. (This is not contraindicated since the bleeding tendency has been corrected.) While awaiting for the anesthetic to take complete effect, one man goes about constructing a compound stent which will be used to apply pressure locally and to retain any local hemostatic medicaments to be placed into the sockets. Two trays have been prepared preoperatively, one containing the necessary prosthetic material for the manufacture of the stent and the other (a sterile surgical tray) containing the necessary instruments for the extraction.

The stent is constructed by softening a block of impression compound and securing an impression of the operative site in centric occlusion. Care

is taken to include an intact area on either side of the operative site to assure stability. A thickness of ⅛ to ¼ inch is maintained to permit strength to withstand heavy biting pressure, but the stent is not so thick as to place a strain on the musculature of the jaws. The device is trimmed, polished, and checked to make sure that there is no interference with swallowing and that no soft tissue abrasion will result. It is then stored in a cold sterilizing medium to await its use following surgery.

The first dentist now proceeds with the extraction in the most gentle and atraumatic manner possible. The bone and soft tissue are manipulated as little as possible, and great care is taken not to injure any other teeth, the tongue, or the cheeks during the extraction. The parts are firmly coapted following the surgery. Three cones are fashioned from strip Gelfoam. Thrombin powder and liquid thrombin have been prepared in advance. Thrombin powder is placed into the socket. The first cone is moistened in the liquid thrombin and then dipped into the dry powder. It will now act as carrier and plunger for the thrombin into the deepest recesses of the socket. This initial piece is pressured with the second cone to the level of the alveolus, and the third piece is placed into the appropriate area of the stent to pressure the initial two. The dentist then brings the stent into the mouth, making sure that the lips of the wound are coapted to prevent their eversion later. The patient bites into the stent in the predetermined position, and fixation and immobilization are established by the application of a modified Kingsley headcap. This is simply constructed by placing an ordinary operating room cap on the patient's head and pinning a double-thickness elastic bandage to it. It passes across the chin, producing a slight superior posterior pressure, and causes a firm closure of the jaws into the stent maintaining the parts and medicaments. Postoperative orders are given that this is not to be disturbed for the first forty-eight hours. Following this period, the headcap may be removed by day, the stent being maintained by jaw pressure, but it is always replaced at night before sleep. The patient is placed on a fortified liquid high-protein diet, and appropriate measures to control pain and establish mouth hygiene are prescribed. Plasma is given after the extraction, and approximately one unit every twelve hours is given thereafter for four to five days postoperatively. Unless plasma is given every day for four days postoperatively, bleeding begins and healing is retarded. The dentist does not disturb the packing unless bleeding becomes profuse. After four days, if the patient's response has been good, plasma is discontinued and the patient is kept for twenty-four hours without plasma. If there is no bleeding, the patient is discharged. Experience seems to indicate that there is practically no hemorrhage for the first forty-eight hours, after which there is some oozing for several days. Good evidence of epithelization is seen by the fifth day, and discharge from the hospital is advised twenty-four hours following cessation of bleeding and plasma administration.

With this technique approximately forty extractions have been successfully performed upon patients with hemophilia of all degrees of severity.

Several cases of traumatic injury to lips and cheeks, where a large persistent jellylike clot was found with persistent bleeding, have been treated. Here a loose ligature of 0 silk is tied close to the base of the clot. Within forty-eight hours the bleeding stops and the clot seems to necrose and drop away, leaving a healed, clean undersurface.

SURGICAL PRINCIPLES

1. All hemophiliacs requiring oral surgery must be hospitalized.

2. Adequate pre- and postoperative transfusions of plasma are essential to achieve hemostasis.

3. A characteristic of the above technique is virtually complete hemostasis for the first forty-eight hours.

4. Only the most conservative means are to be employed in the surgical procedure, both in planning and in execution.

5. The safety of the patient and the success and ease of treatment depend on careful case selection, adequate preparations, proper medication, and the use of a conservative approach.

OBSERVATIONS AND DISCUSSION

Hemophiliacs range from those barely afflicted to those who are very severe bleeders and those who cannot be effectively treated with plasma. In addition, a person will often go through phases during which his bleeding tendency clinically seems intensified, so that the same person at different times will respond differently. Plasma is absolutely essential for hemostasis of any degree. Local means will at times cause coagulation, but this rarely lasts long enough for an appreciable injury to heal. The result is that the patient will receive many units of plasma or blood during his lifetime, sometimes running into the hundreds of units. The early years are the most difficult for the hemophiliac, both in terms of bleeding episodes and in unawareness of the severity of the problem. As the patient matures, the condition appears to ameliorate. Most patients, as they mature, are aware of the problem of hemophilia and are very cooperative. This results in more successful treatment.

Dentally speaking, hemophiliacs are subject to all the ills of normal patients. Dental decay, periodontal disease, accidents, exfoliation difficulties, and impacted teeth are important to all patients, but to hemophiliacs these things are especially serious. The danger to hemophiliacs lies not in any structural defect of the dentition but in their bleeding tendency. The dentist must work closely with the physician and hematologist. However, given a hemophiliac who can be supervised from infancy, we believe that it is possible for such a person to go through life with but little more difficulty dentally than any other person. There is a real need here which dentistry can and should meet.

REFERENCES

1. Moss, Robert L.: Fresh Frozen Plasma—Use in Management of a Hemophiliac, ORAL SURG., ORAL MED. & ORAL PATH. **8**: 27-33, 1955.
2. Pekarsky, R. L.: Oral Surgery and the Hemophiliac, New York State Dent. J. **21**: 205-206, 1955.
3. Hanson, A., and Lannon, J.: High Thigh Amputation in Hemophilia, South African M. J. **28**: 398-400, 1954.
4. Archer, W. H., and Zubrow, H. J.: Fatal Hemorrhage Following Regional Anesthesia for Operative Dentistry, ORAL SURG., ORAL MED. & ORAL PATH. **7**: 464-470, 1954.
5. Archer, W. H., and Zubrow, H. J.: Hemophilia: The Pre- and Postoperative Treatment, ORAL SURG., ORAL MED. & ORAL PATH. **3**: 1377-1381, 1950.
6. Archer, W. H.: Postextraction Bleeding in a Hemophiliac, ORAL SURG., ORAL MED. & ORAL PATH. **4**: 845-849, 1951.
7. Cooper, Robert, and Young, R. S.: Treatment of a Hemophiliac in Deciduous Extractions, ORAL SURG., ORAL MED. & ORAL PATH. **1**: 312-313, 1948.
8. Quick, A. J.: A Classification of Hemorrhagic Diseases Due to Defects in Coagulation Mechanism of the Blood, Am. J. M. Sc. **199**: 118, 1940.
9. Fleuchaus, P. T.: Prolonged Hemorrhage Following Extraction in a Hemophiliac, ORAL SURG., ORAL MED. & ORAL PATH. **7**: 720-725, 1954.
10. Lindsay, W. R., Suher, Theodore, and Chatterjea, S. P.: Management of a True Hemophiliac Requiring Extraction of a Primary Tooth, ORAL SURG., ORAL MED. & ORAL PATH. **6**: 274-277, 1953.
11. Minot, G. R., and Taylor, F. H. L.: The Clinical Use of Anti-Hemophilic Globulin, Ann. Int. Med. **26**: 363-367, 1947.
12. Levine, Paul, and Rubin, Benjamin: Dental Management of the Hemophiliac. In Hemophilia & Hemophilioid Diseases, pp. 210-213, 1957.
13. Nichols, F. C., and Baldridge, O. L.: Multiple Extractions for the Hemophiliac, ORAL SURG., ORAL MED. & ORAL PATH. **12**: 31-42, 1954.
14. Rosenthal, M. C., and Sanders, M.: Plasma Thromboplastin Deficiency; Inheritance and Therapy, Am. J. Med. **16**: 153-162, 1954.
15. Symposium: What Is Hemophilia? Blood **9**: 254-257, 286-290, 291-293, 1954.
16. Ogden, I. W.: Establishment of Diagnosis; Case Involving Dental Extractions, ORAL SURG., ORAL MED. & ORAL PATH. **8**: 1245-1249, 1955.

PERIODONTICS

STUDIES ON THE ETIOLOGY OF PERIODONTOSIS

I. The Role of Vascular Changes in the Periodontium

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INTRODUCTION

RECENTLY we had the opportunity to study histopathologic sections from a patient diagnosed as suffering from third-stage periodontosis. In reviewing the literature related to this pathologic condition, we found that the interpretations of periodontosis and periodontitis are in need of some clarification. Box[1] attempted to describe the generic condition of periodontitis and classified the disease specifically as periodontitis, acute and chronic. Orban and Weinmann[2] categorized periodontosis into three stages. In both cases, however, the line of demarcation between periodontosis and periodontitis, as interpreted by the above-mentioned workers, was not clearly made.

Distinguishing between periodontosis and periodontitis is of extreme importance to both the clinician and the student of histopathology, since the cause and treatment of the two conditions are specific. Periodontosis is strictly a nonexogenically produced inflammatory or noninflammatory histopathologic condition, initiated by the disarrangement of the fibrous elements of the periodontal membrane, followed by the occlusion of the vascular elements which, in turn, initiates the osteoclastic and cementoclastic activities. (Evidence of this is given below.) On the other hand, periodontitis is a secondary inflammatory condition which is brought about by the introduction of an exogenic etiological agent, such as calculus, bacteria, etc. The specific degree of periodontosis is an important factor in the introduction of periodontitis, since it is mainly in the third stage of periodontosis, where inpocketing of gingival tissue is present, that periodontitis is initiated.

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Several earlier descriptions[3-7] and interpretations[1, 2, 8] are found in the literature. Orban and Weinmann,[2] as stated before, recognize three stages of periodontosis—the first characterized by the degeneration of the fibrous elements of the periodontal membrane; the second, by the rapid migration of the epithelial lining along the cementum of the affected area; and the third, by the degeneration of the epithelium at the bottom of the gingival crevice, causing the manifestation of pockets. The ultimate stage is generally accompanied by inflammation and destruction of the supporting tissues. The secondary characteristics of each stage have been adequately described by Orban and Weinmann.[2]

Box[1] categorized periodontitis into two major groups—acute and chronic. He further subdivided chronic periodontitis into the simplex and complex types, dependent on the origin and direction of pathogenicity. Periodontitis simplex, accordingly, is initiated in the gingival tissue as the result of some exogenic etiological agent. The resulting inflammatory processes may invade the deeper tissues, leading to an involvement of the alveolar bone, periodontium, and cementum. On the other hand, periodontitis complex is interpreted as originating in the periodontium, and if further tissue involvement occurred this would always be in the direction toward the gingiva.

These systematic classifications of periodontosis and periodontitis appear to be adequate in the diagnosis of clinical and especially histopathologic sections. From an etiological standpoint, however, information concerning the naturally continuous process is wanting. The following section contains a report of a case of third-stage periodontosis which sheds some evidence on the mechanics of the progression of the disease. The observations reported below suggest that blood vessel changes in the periodontium may be responsible for the initiation of bone and cementum resorption. Current experimental work being carried on in this laboratory may contribute further information with regard to the genesis of this pathologic condition.

MATERIALS AND METHODS

The teeth were extracted under Novocain-Pontocaine-Cobefrin block anesthesia after clinical and roentgenographic examinations of the infected area had been completed. The extracted teeth were fixed in dilutions of formalin, ranging from 3 per cent to 10 per cent, for a period of two weeks. A modification of the University of Pennsylvania Celloidin Technique, as described by Jones,[9] was used.

The teeth were decalcified in a 2.5 per cent aqueous solution of nitric acid for a period of seven days and then washed in running tap water for twenty-four hours. The teeth were then placed in a 5 per cent solution of sodium sulfate overnight. The tissues were dehydrated by means of an ethyl alcohol series and stored in ether. The decalcified teeth were removed from the ether and placed in a dilute solution of parlodion (6 to 8 grams of parlodion in 500 c.c. of equal parts of absolute alcohol and ether). After one

week the tissues were transferred to a more concentrated solution of parlodion (15 grams of parlodion in 500 c.c. of equal parts of absolute alcohol and ether). The teeth and surrounding parlodion were individually mounted on mounting blocks and immediately placed in chloroform to harden. When the hardening process was completed, the teeth were cut into sections 15 microns thick and placed in 95 per cent alcohol. The sections were stained with hematoxylin and eosin and Mallory's triple connective tissue stain, cleared in creosote, and mounted.

HISTOLOGIC OBSERVATIONS

In the pathologic sections, the principal fibers within the periodontium were disorganized and disarranged; none were seen to be connected with either the cementum or the alveolar bone (Fig. 1). The appearance of the

Fig. 1.

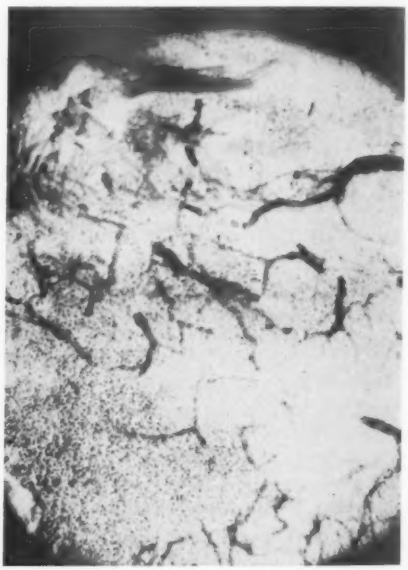

Fig. 2.

Fig. 1.—Photomicrograph of periodontium showing disarranged fibers opposing resorbed cementum. *PF*, Disarranged principal fibers; *BV*, blood vessel; *CEM*, resorbed cementum. (Hematoxylin and eosin stain. Magnification, ×970; reduced ⅙.)

Fig. 2.—Photomicrograph of periodontium showing increased vascularity. (Mallory's triple stain. Magnification, ×120; reduced ⅙.)

ground substance was not observed to be any different from that in normal tissue. Increased vascularity in the form of veins, arteries, and glomi was observed; however, an increase in the density of the capillary bed as reported by Orban and Weinmann[2] was not observed (Figs. 2, 3, and 4). The presence of glomi in the periodontium associated with periodontosis has not been

Fig. 3.—Photomicrograph of periodontium showing disarranged fibers and the presence of glomi. *G*, Glomus; *CTC*, connective tissue capsule; *F*, disarranged fibers. (Hematoxylin and eosin stain. Magnification, ×970; reduced ⅙.)

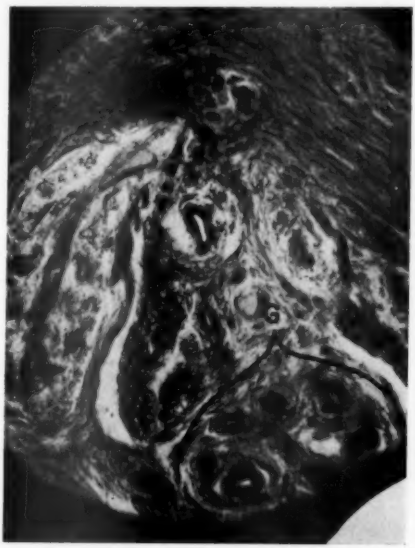

Fig. 4.—Photomicrograph of periodontium showing presence of glomi. *G*, Glomus. (Hematoxylin and eosin stain. Magnification, ×970; reduced ⅙.)

reported previously. Current studies are being carried out in this laboratory to investigate possible explanations for the presence of these arteriovenous anastomoses (glomi) associated with periodontosis and periodontitis.

Relative to the increase in the number of veins and arteries, a detailed quantitative study of the diameters of the vessels associated with osteoclasia and cementoclasia revealed a significant decrease in their dimensions. Table I demonstrates this phenomenon.

TABLE I. MEASUREMENTS OF DIAMETERS OF BLOOD VESSELS IN THE PERIODONTIUM

	NORMAL (CONTROL)			PERIODONTOSIS		
	RANGE (MM.)	AVERAGE (MM.)	NO. OF VESSELS MEASURED	RANGE (MM.)	AVERAGE (MM.)	NO. OF VESSELS MEASURED
Arteries	0.014-0.049	0.021	43	0.007-0.018	0.011	30
Veins	0.014-0.053	0.028	37	0.012-0.035	0.018	33

The veins found in the control periodontium (healthy tissue) averaged 0.028 mm. in diameter, whereas those found in the corresponding region in pathologic tissue were only 0.018 mm. in diameter. Morphologically, this decrease in venous diameter is accounted for by the severely constricted appearance of the vessels. In many cases the lumina were completely occluded. Similarly, the arteries which measured 0.021 mm. in diameter in normal tissue were 0.011 mm. in the pathologic areas. Most of these vessels were also observed to be completely or partially occluded (Figs. 4 and 5).

The occlusion of the blood vessels appears to be directly attributed to their being strangulated by the disarranged fibrous elements, since bundles of fibers were observed to be tightly wound around blood vessels (Fig. 5). It is postulated that the increase in the number of blood vessels represents an attempt to compensate for the decrease in circulation as a result of the vessel occlusions.

Other than the differences given above, the veins and arteries were comparable in their histologic make-up with those described from other tissues of the body.

The areas of the resorbed cementum, which appear as irregular indentations on the surface of the cementum, are restricted in their locations to those areas opposing periodontium in which the fibers are extremely disarranged and the blood vessels are noticeably more numerous and constricted (Figs. 1 and 6). The cementoblastic layer is completely absent where these concavities are seen. The size of the resorbed areas is dependent upon the duration of cementoclasia.

Osteoclasts and cementoclasts were not seen in the areas of bone and cementum resorption. A few epithelial rests were observed, but these are not correlated with resorption, inasmuch as they appear with equal frequency in healthy tissues.

DISCUSSION

The nomenclature related to the various phases of periodontology, especially that referring to periodontosis and periodontitis, is in need of

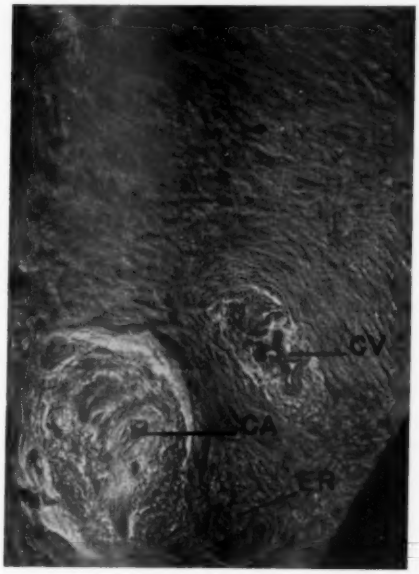

Fig. 5.—Photomicrograph of periodontium showing occluded vein and arteriole. *CV*, Constricted vein; *CA*, constricted arteriole; *ER*, epithelial rest. (Hematoxylin and eosin stain. Magnification, ×430; reduced ⅙.)

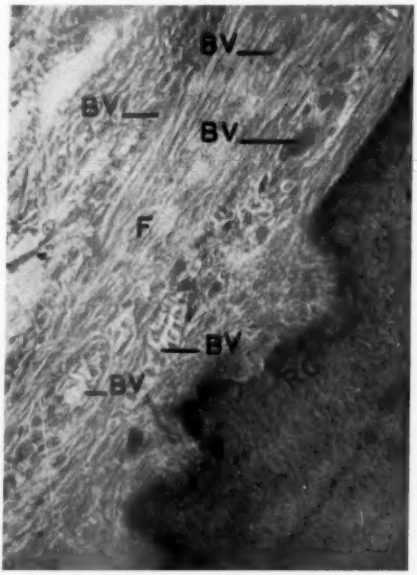

Fig. 6.—Photomicrograph of resorbed area of cementum opposing periodontium. Notice increased vascularity. *BV*, Blood vessel; *F*, disarranged fibers; *RC*, resorbed cementum. (Hematoxylin and eosin stain. Magnification, ×400; reduced ⅙.)

clarification. Lyons, Kerr, and Hine,[18] in the report of the 1949 Nomenclature Committee of the American Academy of Periodontology, defined periodontitis as: "inflammatory involvement of the periodontium. Periodontitis simplex—sequela of gingivitis. Periodontitis complex—periodontitis secondary to periodontosis. The condition may be further defined and described by such adjectives as acute, chronic, ulcerative, purulent (suppurative), etc." Periodontosis is defined as: "A general term to include a degenerative non-inflammatory destruction of the periodontium originating in one or more of the periodontal structures, characterized by migration and loosening of the teeth in the presence or absence of secondary epithelial proliferation and pocket formation or secondary gingival disease. It is possible to subdivide cases of periodontosis into several sub-divisions." These definitions are not in complete keeping with the earlier meanings attributed to the terms. The earlier definitions, which were reviewed in the introduction, are more specific and more logical from the standpoint of histopathology and should be the preferred ones, since it seems highly irregular and inadvisable to modify or alter the definition of terms lest such should lead to confusion.

From what we can ascertain, the specific misunderstanding in the usage of the terms "periodontosis" and "periodontitis" rests in the misinterpretation of the suffixes "-osis" and "-itis." According to Denton's[17] definitive treatise on dental terminology, the suffix "-itis" can be used to describe an infection as well as an inflammation, while the suffix "-osis" designates an unspecified action. Hence, the classification of periodontosis and periodontitis, as given in the introduction, is in keeping with the proper usage of the terms, and the third-stage periodontosis need not necessarily be categorized as periodontitis since the latter must, by specific definition, be the resultant condition introduced by an exogenic etiological agent.

The question of the etiogenesis of periodontosis has been the subject of some speculation. However, the question of the exact mechanisms leading to the pathologic condition remains unresolved. Aisenberg and Aisenberg[10] suggested that the presence of the ground-substance-dissolving enzyme, hyaluronidase, may play a role in the disarrangement of the fibrous elements in the periodontium, and by the introduction of hyaluronidase into the area in monkeys they were able to bring about an experimentally produced condition similar to first-stage periodontosis. The question as to whether the presence of hyaluronidase is actually the natural precursor of periodontosis cannot be adequately answered until further evidences are available. Boyle,[14] Boyle, Bessey, and Wolbach,[15] and Goldman[16] all suggested that the deficiency of vitamin C may be directly responsible for alveolar atrophy; however, this hypothesis also is in need of more sophisticated investigation.

The fact that the fibrous elements in the periodontium are disarranged in periodontosis is universally accepted. From the data presented above, it seems evident that the disorganization and disarrangement of these fibers are in part directly responsible for the occlusion of the blood vessels in the area. These occlusions naturally lead to a decrease in the supply of nutrients and a

build-up of metabolic wastes in the periodontal membrane. This unnatural condition of the periodontium leads to osteoclastic and cementoclastic activities. This conclusion is supported by the abundance of occluded vessels seen adjacent to resorbed areas. These resorbed areas are identical to the Howship's lacunae normally associated with periosteal osteoclasia.

The actual mechanism of resorption of the alveolar bone and the cementum is still not clear. It is presumably the result of the activity of osteoclasts and cementoclasts, but these multinucleate cells were not always seen in the areas of resorption. According to Orban,[11] this phenomenon can be explained by the fact that the osteoclasts and cementoclasts have disappeared shortly after resorption has been initiated. The more recent work with the enzyme alkaline phosphatase (thought by some to be a composite of several enzymes[12]) has shown that this substance, which can be elaborated by decomposed organic materials,[13] is capable of dissolving calcium phosphate and calcium carbonate, and hence the resorption of bone and cementum may well be the immediate result of alkaline phosphatase or an alkaline phosphatase-like enzyme secreted by the osteoclasts and cementoclasts, which are in actuality degenerating osteoblasts and cementoblasts. This working hypothesis is being investigated currently in our laboratory.

SUMMARY

A redefinition and clarification of the classification of periodontosis and periodontitis are given; we are of the opinion that the original definitions of these terms should be retained. Histologic investigation of a case of third-stage periodontosis strongly suggests that the disarranged fibrous elements of the periodontium are responsible for the complete and/or partial occlusion of the blood vessels within the area and, in turn, this condition is responsible for the initiation of osteoclastic and cementoclastic activities.

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REFERENCES

1. Box, H. K.: Studies in Periodontal Pathology, Toronto, 1924, Canadian Dental Research Foundation.
2. Orban, B., and Weinmann, J.: Diffuse Atrophy of the Alveolar Bone (Periodontosis), J. Periodont. **13**: 31, 1942.
3. Gottlieb, B.: Diffuse Atrophy of the Alveolar Bone, Ztschr. Stomatol. **21**: 195, 1923.
4. Kronfeld, R., and Mueller, E.: A Case of Generalized Tooth Resorption, Ztschr. Stomatol. **29**: 276, 1931.
5. Mueller, E., and Rony, H. R.: Laboratory Studies of an Unusual Case of Resorption, J. Am. Dent. A. **17**: 326, 1930.
6. Mueller, E.: Histological Study of a Case of Extensive Root Resorption in a Human Being, J. Am. Dent. A. **18**: 684, 1931.
7. Gottlieb, B.: Etiology and Therapy of Alveolar Pyorrhea, Ztschr. Stomatol. **18**: 59, 1920.
8. Thoma, K. H., and Goldman, H. M.: Classification and Histopathology of Paradental Disease, J. Am. Dent. A. **18**: 684, 1931.

9. Jones, R. M.: McClung's Handbook of Microscopical Technique, New York, 1950, Paul B. Hoeber, Inc.
10. Aisenberg, M. S., and Aisenberg, A.: Hyaluronidase in Periodontal Disease, ORAL SURG., ORAL MED. & ORAL PATH. **4**: 317, 1951.
11. Orban, B.: Oral Histology and Embryology, St. Louis, 1957, The C. V. Mosby Company.
12. Gomori, G.: Microscopic Histochemistry, Chicago, 1952, University of Chicago Press.
13. Goldschmiedt, H., Mettenleiter, M. W., and Borchardt, P. R.: Presence and Function of Alkaline Phosphatase in Seawater, Turtox News **36**: 269, 1958.
14. Boyle, P. E.: Dietary Deficiencies as a Factor in the Etiology of Diffuse Alveolar Atrophy, J. Am. Dent. A. **25**: 1436, 1938.
15. Boyle, P. E., Bessey, O. A., and Wolbach, S. B.: Experimental Production of Diffuse Alveolar Bone Atrophy Type of Periodontal Disease by Diets Deficient of Ascorbic Acid (Vitamin C), J. Am. Dent. A. **24**: 1708, 1937.
16. Goldman, H. M.: Periodontosis in the Spider Monkey; a Preliminary Report, J. Periodont. **18**: 34, 1937.
17. Denton, G. B.: The Vocabulary of Dentistry and Oral Science, Chicago, 1958, American Dental Association.
18. Lyons, H., Kerr, D., and Hine, M. K.: Report of 1949 Nomenclature Committee of the American Academy of Periodontology, J. Periodont. **21**: 40, 1950.

ORAL MEDICINE

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ORAL LESIONS IN INFECTIOUS MONONUCLEOSIS

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INFECTIOUS mononucleosis has been known by different names. The most common alternative designation, and one which is widely used in this country, is "glandular fever."

The condition presents a sufficiently definite picture to justify considering it an entity. It is an acute infectious disease of unknown etiology, characterized by fever, enlargement of the lymphatic glands, and changes in the blood, especially lymphocytosis and the presence of heterophil antibodies.

The typical blood changes and the laboratory criteria for making the diagnosis certain may not appear for several days after the onset of symptoms. This fact and the great variability of the symptoms and physical manifestations, often accompanied by complications, combine to make the illness a diagnostic problem.

Bernstein,[1] writing in 1940, contended that if laboratory investigations were used routinely, many cases originally diagnosed as Vincent's infection, acute stomatitis, aphthous ulceration, agranulocytosis, etc. would be shown to have been infectious mononucleosis.

Werlin and associates[2] treated a series of twenty-one cases of infectious mononucleosis in hospitals, and they reported that all were referred with a mistaken diagnosis.

Kilham and Steigman,[3] writing in the *Lancet*, drew attention to the growing awareness of the diagnosis and reported that one-third of their cases were referred with a correct diagnosis.

In 1930 the full course of one type of the entity (the febrile type) was recognized when an extensive epidemic swept Great Britain.

About this time Paul and Bunnell[4] made the discovery that the blood in infectious mononucleosis contains heterophil antibodies, a phenomenon which apparently is almost pathognomonic of this disease. This remarkable phenomenon was discovered by these two workers in the course of routine investigations. Briefly, heterophil antibodies in human blood are agglutinins and

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hemolysins to sheep's red corpuscles. Normal human blood may contain such antibodies in a titer not exceeding 1 in 8. In infectious mononucleosis, the titer may rise to 1 in 4,096. The rise begins early and rapidly attains the maximum. Thereafter, there is a fall in titer and the normal may be reached in six weeks.

INFECTION

The degree of infectivity is not high, and statistics show that it is comparatively uncommon for more than one case to occur in a household. It would appear that sporadic cases tend to be of a more severe type than those which occur in epidemics.

CLINICAL TYPES

While three distinct clinical types are now generally accepted, it should be stated that any combination of these types may occur.

1. The glandular or Pfeiffer type has as its outstanding feature enlargement of the glands. Sore throat is often present, but there is no exudation. It is most common between the ages of 5 and 15 years.

2. The anginose type is characterized by the appearance of a membrane over the throat or in the oral cavity. It is less common than the glandular type. It is seen usually in patients 15 to 30 years of age.

3. The febrile type occurs most typically in adults, although it is sometimes seen in children.

REPORT ON A SERIES OF 140 CASES

These cases were observed over a period of nine years. While it was possible to divide the majority of the cases into one of the three types described—glandular, anginose, or febrile—several of the cases appeared to be a combination of types and followed atypical courses.

Faucial and Pharyngeal Lesions.—Seventy-seven of the patients complained of sore throat. The objective changes in forty-nine of these patients consisted of a redness of the fauces, the tonsils (when present), and the posterior pharyngeal wall. The pharyngeal lymphoid tissue and the tonsils were swollen in twenty-three of the patients.

Faucial and Pharyngeal Membrane.—Forty-four of the 140 cases were classed as the anginose type. The exudate varied from a few flakes to an extensive membrane similar to that present in diphtheria. The color varied from white to dull gray, and in 10 per cent of the anginose types there was a distinct green coloration in the membrane. On removal, the membrane appeared to be less adherent than that of diphtheria.

Only a few of these cases appeared to have any noticeable or distinctive odor. When present, it was a faint, musty, rather unpleasant smell, reminding one of damp, decaying vegetation.

Lesions in the Mouth.—It should be stated at the outset that the oral lesions found in infectious mononucleosis are not uncommon and like many of the other symptoms present in this disease, they are quite variable.

Fig. 1.

Fig. 2.

Stomatitis.—Acute stomatitis with associated gingivitis was found in thirty-eight of the patients. A few of these patients had bleeding from the gingivae (Fig. 1). Three patients had enlarged, engorged gingivae with a definite blue appearance and presented an oral and clinical picture resembling leukemia (Fig. 2).

A pronounced similarity to scurvy was observed in two cases (Fig. 3). There was acute pericoronitis over an erupting lower third molar in seven cases.

Most of these cases were of the early anginose type or a combination of types. In 50 per cent of the cases with stomatitis the oral symptoms were the first clinical symptoms.

Fig. 3.

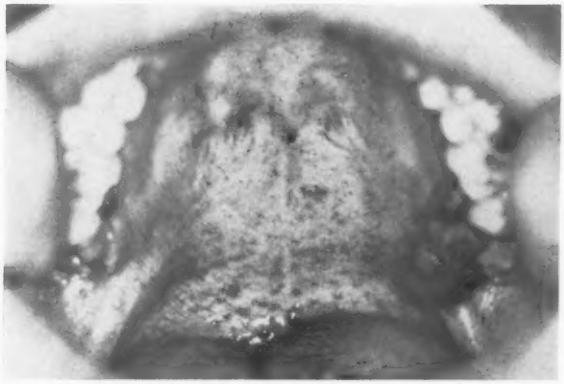

Fig. 4.

Membrane in the Mouth.—Extensive membranes were present in the mouth in eight of the cases, and small patches were present in another five cases. In six cases the membrane was in the buccal sulcus in the lower molar region where buccal mucosa was in opposition with mucoperiosteum covering bone. In three cases the membrane was confined to the floor of mouth and the under surface of the tongue. The membrane appeared around a pericoronitis in three cases and around the socket of a recently extracted lower third molar in two cases.

The membranes were found either in the anginose type or in the cases where there appeared to be a combination of types.

Ulceration.—Four cases had a few areas of ulceration with no evidence of a membrane.

Petechiae.—Extensive petechiae were present in seven cases. All these cases were of the febrile type. The petechiae appeared at about the same time as the rash in five cases and with the onset of icterus in one case.

The distribution was irregularly arranged in the mucosa of the palate (Fig. 4).

In fourteen of the cases in this series the diagnosis was first suspected from oral lesions. Three of these cases are of particular interest to the dental surgeon and are recorded here in some detail.

CASE 1.—In this case glandular fever developed following a difficult extraction, and the diagnosis at first was obscure.

The patient, a 21-year-old woman, had an impacted lower third molar removed in a nursing home under general anesthesia. Swelling and trismus followed this operation, but the patient was able to go home on the fourth day.

When she visited her dental surgeon on the tenth postoperative day, the socket and the mouth appeared satisfactory. Two days later, however, she complained of feeling ill, the discomfort in the extraction area returned, and she was forced to remain in bed.

Fig. 5.

Her medical practitioner visited her and found that she had a temperature of 102° F. He considered that she had an acute stomatitis and contacted the dental surgeon.

The gingivae were very swollen and red, with some hemorrhage. There was an extensive membrane, greenish white in color, extending from the lower eighth socket along the buccal sulcus and up the inner aspect of the cheek toward the angle of the mouth (Fig. 5). There was a pronounced oral fetor.

The submaxillary, cervical, axillary, and inguinal glands were enlarged. The spleen was palpable and the liver was tender.

A hemogram taken at the time showed an absolute mononucleosis, and six days later the pathologist found that the blood contained heterophil antibodies.

Chloramphenicol was prescribed, together with active local treatment for the oral condition. The membrane peeled off without difficulty, and normal saline (warm) was used in an atomizer. Mouthwashes and occasional anesthetic lozenges rendered the mouth more comfortable.

The recovery was good. The patient was out of bed at the end of ten days and back at work in four weeks.

CASE 2.—A 17-year-old male student was referred to the hospital for treatment of persistent Vincent's infection.

The oral mucous membrane was slightly congested, and the patient complained that the mouth was hot and very sensitive. A grayish white patching membrane was present on the floor of the mouth and over a small area on the under surface of the tongue.

He had received local treatment from his dental practitioner for ten days, but the oral condition was deteriorating.

The temperature was 101° F.

Examination revealed enlargement of the cervical and axillary glands. Blood examination showed the typical findings of infectious mononucleosis—absolute mononucleosis and a positive Paul-Bunnell test.

A smear taken from the mouth contained mainly streptococci with some fusiform bacilli and spirochetes.

The patient was admitted to the hospital, where he received systemic and local treatment.

Recovery was slow in this case, and it was more than two months before the patient was able to resume his university studies.

CASE 3.—A 23-year-old woman was admitted to the hospital for investigation of a fever of unknown origin. She had been in bed at home for five days, with a temperature ranging between 100 and 103° F. There were very few clinical signs.

Three days before the onset of the fever the patient had visited her dental practitioner and had received treatment which included scaling and polishing of the teeth.

When she was examined after admission to the hospital, it was observed that she had a mild generalized stomatitis. A few petechiae were present on the soft palate (Fig. 4). Blood examination showed mononucleosis, and the Paul-Bunnell test was positive. In this case the glands and spleen did not enlarge until the third week.

Recovery was slow, and the convalescence was further prolonged by a relapse.

ORAL LESIONS REPORTED IN CASES OF INFECTIOUS MONONUCLEOSIS

A review of the literature on this entity revealed a number of reports on oral lesions. Baldridge, Rohner, and Hansmann,[5] in 1926, reported sore and bleeding gingivae in a number of cases.

Contratto,[6] in a monograph published in 1944, quoted his findings in 196 cases. In thirteen patients he found "tender, bleeding gums, often spongy and swollen, sometimes ulcerating." He found that the involvement of the gingivae frequently preceded the inflammation of the throat and in some cases was more severe. This often led to a diagnosis of Vincent's angina early in the disease.

Contratto continues: "From this experience I feel that many patients who display nothing more than bleeding and tender gums, which may be either swollen or spongy or both, may well have infectious mononucleosis."

Spangenberg[7] referred to one case in which he considered infectious mononucleosis a complication of the removal of an impacted third molar.

Cottrell[8] cited one case in which an inflamed operculum over a partially erupted lower third molar was an early symptom in the disease. He affirmed that the disease with which this is most likely to be confused in diagnosis is acute lymphocytic leukemia.

Bernstein,[1] in a most comprehensive survey of this condition, made reference to the frequent occurrence of stomatitis and oral ulceration. While reports show that involvement of the salivary glands is rare, Bernstein treated six cases in which the submaxillary and sublingual glands were extensively affected. He also cited instances in which swelling of the parotid glands in the early stages of infectious mononucleosis had been mistaken for mumps.

Glanzmann[9] gives many details of the oral lesions that he found. Herpes labialis is considered to be uncommon in infectious mononucleosis, but he noted its occurrence in cases in children. In describing various forms of stomatitis found, he wrote of a scorbutic-like reddening and swelling of the gingivae. He mentioned also tiny papular lesions on the palate which became confluent and a granular appearance of the mucous membrane of the lower lip. He attributed both of these phenomena to lymphatic obstruction. In four of his cases he found widely distributed aphthous lesions. He also discovered that many of the cases of stomatitis in this condition had a spirochetal infection and that there was evidence of the characteristic manifestations of Vincent's stomatitis.

SUMMARY

The early symptoms of infectious mononucleosis are quite varied, and some of the common clinical features have been enumerated.

Accurate diagnosis is difficult in the early stages.

The blood picture is characteristic in a well-established case, and a positive Paul-Bunnell test is pathognomonic of the disease. While it may generally be stated that a positive reaction is proof of glandular fever and a negative reaction does not exclude it, the cases included in this series all had a positive Paul-Bunnell.

The oral lesions are of particular interest to the dental surgeon. These were prominent features in forty-five of the 140 cases reported in this article.

It is of interest to note that in seven cases some form of dental treatment was given within a few days of the onset of the disease.

In patients presenting atypical, persistent, or severe stomatitis, infectious mononucleosis should be borne in mind.

REFERENCES

1. Bernstein, A.: Infectious Mononucleosis, Medicine **19:** 85, 1940.
2. Werlin, S. J., Dolgopol, W. B., and Stern, M. E.: Am. J. M. Sc. **201:** 474, 1941.
3. Kilham, L., and Steigman, A. J.: Lancet **11:** 457, 1942.
4. Paul, J. R., and Bunnell, W. W.: Am. J. M. Sc. **183:** 90, 1932.
5. Baldridge, C. W., Rohner, F. J., and Hansmann, G. H.: Arch. Int. Med. **38:** 413, 1926.
6. Contratto, Andrew W.: Arch. Int. Med. **73:** 449, 1944.
7. Spangenberg, H. D., Jr.: J. D. Res. **20:** 244, 1941.
8. Cottrell, James E.: J. Periodont. **9:** 15-25, 1938.
9. Glanzmann, E.: Das lymphaemoidi Drüsenfieber, Berlin, 1930, S. Karger.

THROMBOCYTOPENIC PURPURA DUE TO QUININE, WITH ORAL SYMPTOMS

Report of a Case

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IT IS well known that purpura may be induced by the administration of a variety of drugs, among which is quinine.[1-3] Burket[4] mentions oral symptoms occurring with quinine-induced purpura, but there appears to be no reference to any cases in the dental literature. However, there are listed in the medical literature some cases in which oral symptoms have been observed.[5, 6] The purpuric reactions of this type have been shown to be a manifestation of specific sensitivity rather than a drug toxicity,[5-8] and following withdrawal of the drug the platelet count returns rapidly to normal.

CASE REPORT

The patient, a 27-year-old married woman, was first examined on July 12, 1956. She reported that during the previous night she had suffered spontaneous hemorrhages from the nose and gingivae.

Clinical Examination of the Oral Cavity.—The patient's oral hygiene was good. There was free hemorrhage from the gingivae, which was especially marked in the upper posterior areas. There were also small hemorrhagic blebs on the cheeks, lips, and tongue, as well as a large hemorrhagic bleb on the mucosa of the left cheek (Figs. 1, 2, and 3). There was dried blood in the nostrils.

The patient was referred for medical examination on July 13, 1956. During the night of July 12 she noticed that spots had appeared on her legs and body, and her urine was red on the morning of July 13.

Medical Examination.—The patient was eight weeks pregnant and stated that one week previously she had started a four-day course of treatment with abortifacient pills obtained from a pharmacist. These were later found to contain quinine and "steel."* She was at first reluctant to admit that she was taking these pills, because of the illegal aspect of such an action, but later she was alarmed by the serious nature of the symptoms. The medical examination revealed a purpuric rash confined mainly to the lower limbs, with several large bruises on the upper thighs. There were petechial hemorrhages on the upper thigh and upper limbs and some on the face. The mouth condition was as described above, but the bleeding from the gingivae had stopped. There was a subconjunctival hemorrhage as well as macroscopic hematuria. The patient was admitted to the hospital on the same day and was given only vitamins K and C and intramuscular iron (imferon 2 c.c. every second day). The hematuria disappeared after three days, and there were no further purpuric spots after two days. In

*Composition unknown, but a well-known abortifacient.

Fig. 1.—Free bleeding from the gingival margin in upper left cuspid and premolar area and large hemorrhagic bleb in cheek.

Fig. 2.—Large hemorrhagic bleb in cheek and small ones in left tuberosity area

Fig. 3.—Small hemorrhagic blebs in upper lip and free bleeding from premolar areas.

addition, the gingival condition was normal by the third day, and on July 20, 1956, the rash had completely faded except for discoloration of the thigh bruises. The patient was then found to be two months pregnant. There was no bleeding from the vagina, and the pregnancy seemed undisturbed. The spleen and liver were not palpable. She was discharged from the hospital on July 21, 1956.

TABLE I. HEMATOLOGIC EXAMINATIONS

	JULY 14, 1956	JULY 19, 1956	AUG. 22, 1956	FEB. 24, 1957
Hemoglobin (Gm./100 ml.)	11.3	12.2	11.6	10.5
Red cell count (million/c.mm.)	3.81*		3.88†	
Color index	0.99		1.01	
Leukocytes	9,450	12,900	9,200	9,500 (normal differential count)
Neutrophils	77%	52%	66%	
Eosinophils		13%	2%	
Lymphocytes	21%	33%	28%	
Monocytes	1%	2%	3%	
Basophils			1%	
Platelets	34,290	387,000	Normal	Normal
Bleeding time (minutes)	14	6.5		

*Red cells showed anisocytosis and polychromasia.

†Normocytic normochromic anemia consistent with pregnancy, iron deficiency. Note the marked drop in platelets and the increased bleeding time and then rapid return to normal.

Further Medical Note.—The patient had mild toxemia of pregnancy in the last two months of pregnancy, necessitating bed rest. On Feb. 19, 1957, she gave birth to a full-term healthy female child. The patient had a more severe toxemia with her first pregnancy, which indicated that this mild toxemia during the second pregnancy was not associated with the purpura.

DISCUSSION AND SUMMARY

A case of thrombocytopenic purpura caused by the administration of quinine is presented. This case showed severe oral symptoms and is of unusual interest since the oral symptoms were the first to appear and consequently the patient first consulted a dentist. Furthermore, the condition was produced by an abortifacient, the administration of which the patient was reluctant to admit. This case could have had more serious consequences if she had been more secretive and more determined to produce an abortion. The condition was characterized by the marked and rapid fall in platelets, the increased bleeding time, and the rapid recovery recorded in similar cases by other authors.[5-7]

I would like to thank Dr. Peggy Anderson for her cooperation in obtaining the medical history for this patient and Mr. G. M. Withycombe for taking the Kodachromes from which these illustrations were made.

REFERENCES

1. Conybeare, J., and Mann, W. N.: Textbook of Medicine, ed. 11, Edinburgh and London, 1954, E. & S. Livingstone, Ltd., p. 287.
2. Whitby, L. E. H., and Britton, C. J. C.: Disorders of the Blood, ed. 5, London, 1947, J. & A. Churchill, Ltd., p. 318.
3. Comroe, B. I., Collins, L. H., and Crane, M. P.: Internal Medicine in Dental Practice, ed. 4, Philadelphia, 1954, Lea & Febiger, p. 361.

4. Burket, L. W.: Oral Medicine, ed. 3, Philadelphia, 1957, J. B. Lippincott Company, p. 250.
5. Steinkamp, R., Moore, C. V., and Doubek, W. G.: Thrombocytopenic Purpura Caused by Hypersensitivity to Quinine, J. Clin. & Lab. Med. 45: 18-29, 1955.
6. Bolton, F. G., and Young, R. V.: Observations on Cases of Thrombocytopenic Purpura Due to Quinine, Sulphamezathine and Quinidine, J. Clin. Path. 6: 320-323, 1953.
7. Larson, R. K.: The Mechanism of Quinidine Purpura, Blood 8: 16-25, 1953.
8. Ackroyd, J. F.: Cited in Larson.[7]

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PHARMACOLOGY AND THERAPEUTICS

PROTEOLYTIC ENZYME-ANTIBIOTIC PREPARATIONS IN THE TREATMENT OF ORAL LESIONS

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INTRODUCTION

THE proteolytic enzymes have been used successfully to treat lesions characterized by infection and fibrinopurulent exudate. The use of maggots for the cleansing of indolent ulcers has been practiced for ages by physicians. This has been effective because of the production of proteolytic enzymes and the digestion of necrotic debris by the maggots. Today the extraction of proteolytic enzymes from mammalian pancreas and the fractionation of purified trypsin has been made available for treating such lesions.[1, 2]

Proteolytic digestion depends upon the configuration of the peptide linkages in protein. The enzymes require access to surface structures of protein to catalyze hydrolysis. In living native protein such structural surfaces are contained within the protein molecule not easily available to proteolytic enzymes. Such conditions resist proteolysis.[3] Furthermore, serum and intercellular fluid contain antienzymes which block enzymes and may inhibit proteolysis.[4] For example, native serum albumin resists hydrolysis by trypsin. When albumin is subjected to heat, however, it is readily hydrolyzed by trypsin.[3] Heat, then, alters the configuration of albumin and changes its nature, making available those structural surfaces upon which enzymes attach to cause hydrolysis. This denaturation of protein by heat can also be accomplished by strong acids or base, salts of heavy metals, mechanical agitation, alcohol, acetone ether, urea, and detergents.

Living tissues subjected to injury by any agent, including microorganisms, may induce denaturation of protein from cells and intercellular substances. Such denatured peptide chains may liberate inflammation-producing agents.[5] The removal of such agents at the site of injury is in part the function of the polymorphonuclear leukocytes. This is accomplished by phagocytosis and intracellular proteolysis.[6] Fibrinopurulent infectious lesions are characterized

From the Foundation for Dental Research, Loyola University School of Dentistry.

by large numbers of polymorphonuclear leukocytes. Such leukocytes die and liberate trypsin enzyme into the lesion. This is inactivated by serum exudate antienzymes limiting extra cellular activity.[4]

Various investigations have been undertaken to observe the effect of proteolytic enzymes frequently combined with antibiotics and surgery on lesions characterized by necrosis, infection, and various quantities of exudate. Severe burns have reacted by digestion of the necrotic tissues, reduced bacterial infection, and resolution of the lesions.[2, 7, 9] Infected wounds have shown evidence of reduced microorganisms, débridement, and resolution.[8-10] Chronic indolent infected ulcers were débrided and the infection was reduced by the use of trypsin, chymotrypsin antibiotic ointment applied topically.[11] Wounds were observed to heal faster when treated with trypsin-antibiotic preparations.

Oral lesions treated with enzymes include acute alveolar osteitis (dry socket) and necrotic pulp. Trypsin powder made into a solution with phosphate (Sorensen's) buffer was used to treat eight cases of necrotic pulp.[12] Negative cultures obtained following such therapy were attributed to the removal of necrotic substrate with the microorganisms from the canals. Similarly, such buffered solutions were used to irrigate the sockets in acute alveolar osteitis.[13, 14] The results of such studies indicated that chemical débridement is a useful aid in the management of acute alveolar osteitis and endodontic therapy. Such findings also suggest that enzyme-antibiotic preparations may be useful in other oral conditions characterized by necrosis and infection.

The dressing used to treat intraoral surgical wounds consists basically of zinc oxide powder, eugenol, and an accelerator to modify the setting time. Such dressings are used for periodontal surgery; soft-tissue trims of the alveolar ridge, vestibule, and palate; immediate denture surgery, and alveolectomy. In the latter cases it usually is placed in the denture to facilitate tissue contact. A common observation of such treatment is the presence of a covering of necrotic debris on the wound surface and on the surface of the dressing. Such necrotic debris contains a mixture of the oral flora, a fibrinopurulent exudate, desquamated epithelial cells, and red blood cells. Surgical dressings maintaining the debris impart a fetid odor. Such dressings are frequently changed at intervals of three to five days until healing is clinically observed to keep the patient comfortable and to maintain sanitation.

The time required for the healing of surgical wounds varies according to the surface area affected, the degree of injury from microorganisms and necrotic tissue, and the health of the patient. Epithelization of such wounds may begin almost immediately, and complete healing may occur in one week. In isolated areas of extensive wounds, healing may be delayed for more than two weeks.

Oral lesions characterized by a fibrinopurulent exudate and infection are common. Acute ulceronecrotizing gingivitis is a typical example; it is characterized by a necrotic cover on the papillary and marginal gingiva teeming with fusospirochetes. Acute alveolar osteitis also shows necrotic tissue and

mixed infection in the alveolus. The surface bone is necrotic in such cases and may sequestrate. Oroantral fistulas and dentoalveolar sinus tracts likewise show mixed microorganisms and fibrinopurulent exudate. Pain and discomfort usually are caused by such lesions. Treatment in these cases consists of antibiotic therapy and surgical intervention. Should this be delayed, serious complications are likely to result.

This report deals with some observations of the effect of enzyme-antibiotic preparations on dressing surgical wounds and infections and fibrinopurulent necrotic oral lesions.

MATERIAL AND METHOD

The proteolytic enzymes trypsin, chymotrypsin, and Mixase A (a purified mixture of proteolytic enzymes) derived from mammalian pancreas and prepared as a powder and ointment were used in this investigation. The antibiotics polymyxin B sulfate, neomycin palmitate, bacitracin, and zinc bacitracin, alone or in combinations, were added to the enzyme preparations to control bacterial infections. The compounds* used are listed in Table I.

TABLE I

SOLUTION	PER GRAM
Powders	
Formula 1	
Trypsin	100,000 A.U.
Zinc Bacitracin	500 U.
Neomycin Palmitate	2.5 mg. base
Formula 2	
Mixase A	10,000 A.U.
Zinc Bacitracin	500 U.
Neomycin Palmitate	3.5 mg. base
Formula 3	
Mixase A	10,000 A.U.
Neomycin Palmitate	3.5 mg. base
Ointments	
Formula 1	
Trypsin	100,000 A.U.
Zinc Bacitracin	500 U.
Neomycin Palmitate	2.5 mg. base
Formula 2	
Trypsin*	5,000 A.U.
Chymotrypsin	5,000 A.U.
Polymyxin B Sulfate	5,000 U.
Bacitracin	500 U.
Formula 3	
Mixase A	10,000 A.U.
Neomycin Palmitate	3.5 mg. base

*Commercially available as Tryptar ointment; Armour Pharmaceutical Company, Kankakee, Illinois.

The differences in concentration of the enzymes and the compounding of powder and ointment were necessary to determine the relative effectiveness of such agents in the saliva-washed oral cavity. For example, ointment Formula 1, prepared with a puttylike consistency containing 100,000 Armour Units of

*Supplied by Dr. H. J. Antonides, Armour Pharmaceutical Company, Kankakee, Illinois.

of trypsin per gram, was used in septic alveolar osteitis. It was believed that a high enzyme concentration in a dense base might resist washing out and liberate the enzyme slowly over a prolonged period of time.

The ointment contained in tubes or jars was transferred to a 10 c.c. Luer Lok syringe with a blunted 10 gauge needle bent to a 45 degree angle. This facilitated intraoral administration. The powder preparations were contained in a polyethylene bottle fitted with a small nozzle which permitted spot spraying.

The enzymic preparations were used for the following conditions:

1. Gingivectomy dressing (eighty cases)
2. Deep periodontal pockets and lateral abscess (seven cases)
3. Acute alveolar osteitis (eighteen cases)
4. Acute ulcerative necrotizing gingivitis (four cases)
5. Immediate denture and soft tissue trim dressings (seven cases)
6. Oroantral fistula (one case)
7. Endodontics (three cases)

The surgical dressings used in this investigation were made from zinc oxide powder to which was added 2 grams of enzyme-antibiotic powder or ointment, eugenol, and an accelerator. The enzyme compounds were added during the spatulation of the dressing. This neither impaired the workability nor the firmness of the final set of dressings.

The lesions were treated by topical application of the ointment or the powder. When used, the dressings were applied ten minutes after topical treatment of the lesions and were changed at three-day intervals until healing resulted.

OBSERVATIONS

1. *Gingivectomy.*—Eighty cases requiring gingivectomy were treated by topical application and dressing with enzyme-antibiotic. In five cases in which the powder only was used, one half of the arch was treated only with a surgical dressing prepared free of enzyme antibiotics.

TABLE II

NO. CASES	PREPARATION	ENZYME		ANTIBIOTIC	
10	Ointment Formula 2	Trypsin	5,000 A.U.	Polymyxin B	5,000 U.
		Chymotrypsin	5,000 A.U.	Bacitracin	500 U.
25	Ointment Formula 1	Trypsin	100,000 A.U.	Neomycin	2.5 mg.
				Zinc Bacitracin	500 U.
20	Ointment Formula 3	Mixase A	10,000 A.U.	Neomycin	3.5 mg.
25	Powder Formula 3	Mixase A	10,000 A.U.	Neomycin	3.5 mg.

The most striking observation was the absence of the gray necrotic debris covering the wound surface, usually seen when such surgical dressings are changed. The wounds looked pink, with granulation tissue covering the surface. This finding also was observed in the five cases in which only one side of the arch was treated with the enzymes. The untreated side showed a

covering of necrotic debris, and the granulation tissue appeared red. The healing time was significantly reduced by from four to seven days. The clinical impression was that the different compounds of enzyme and antibiotics used appeared equally effective.

2. *Acute Alveolar Osteitis.*—Eighteen cases of acute alveolar osteitis were treated with ointment Formula 1 (trypsin, 100,000 A.U. per gram, and neomycin palmitate, 2.5 mg. per gram), which has a heavy, puttylike consistency. Four cases were treated with powder Formula 3 (Mixase A, 10,000 A.U., and neomycin palmitate, 3.5 mg. per gram). The sockets were gently irrigated with warm sterile saline and dried with sterile cotton. The ointment was applied to nearly fill the socket. The powder was sprayed in excess into the sockets. The sockets then were covered with a dressing of zinc oxide and eugenol. Within twenty-four hours the sockets appeared free of necrotic debris, and pink granulation tissue was seen projecting through the alveolar bone surfaces.

3. *Intra-alveolar Pockets.*—Of seven cases of deep intra-alveolar pockets, three presented abscesses. The abscesses were incised, drained, and dressed with Mixase A ointment (Formula 3). Subsequently, all seven cases were treated by means of a mucosal flap, curettage, and spraying with Mixase A powder (Formula 3). The wounds were sutured and covered with a surgical dressing. The wounds healed well and presented clinical evidence of connective tissue reattachment.

4. *Acute Ulceronecrotizing Gingivitis.*—One patient, a medical student, presented extensive gingival and retromolar infection of three days' duration. He was instructed to apply the Tryptar ointment Formula 2 (trypsin, 5,000 A.U., chymotrypsin, 5,000 A.U., polymyxin, 5,000 U., and bacitracin, 500 U.) four times a day. In twenty-four hours the necrotic surfaces were replaced by pink granulation tissue, and there was a reduction in the surface areas of the lesions. The patient obtained symtomatic relief also. In three cases, the lesions were sprayed with powder Formula 3 (Mixase A, 10,000 A.U., and neomycin, 3.5 mg. per gram). Within ten minutes there was clinical evidence of débridement. Such subjects were given the Mixase A ointment Formula 3 with instructions to apply it four times a day. In twenty-four hours the lesions were free of necrosis and presented a pink granular surface. Again it was noted that there was a reduction in the surface areas of the lesions, and the subjects reported symptomatic relief. All cases were free of any lesions in seventy-two hours.

5. *Immediate Denture and Soft-Tissue Trims.*—In four immediate denture cases the Mixase A ointment Formula 3 was placed inside the anterior ridge sulcus of the denture. In three cases of soft-tissue trim, Mixase A ointment Formula 3 was incorporated with a surgical dressing placed in the denture and also applied to the wound surface. Such cases were redressed and observed in twenty-four hours, seventy-two hours, and one week. The wounds were free of necrotic debris, and the surface showed rapid healing.

6. *Oroantral Fistula.*—One case of oroantral fistula of the upper right molar area of three months' duration presented pain and discomfort with

suppuration and polyps of the maxillary sinus. The polyp was removed, which permitted free intraoral drainage. The fistula was gently irrigated with warm saline; this was followed by the introduction of several grams of Mixase A ointment Formula 3. Within seventy-two hours the patient was free of pain and discomfort for the first time in three months. The treatment was continued, and a plastic mucosal closure was done.

7. *Endodontic Therapy.*—Three cases presented teeth with necrotic pulps and periapical radiolucencies. Mixase A powder (Formula 3) was made into a solution with sterile water, about 2 grams of powder to 1 c.c. of water. Such solution was used for irrigation and débridement and sealed in the canals.

The canals were opened and a culture was taken with a sterile paper point. The canals then were irrigated with a 2 c.c. syringe and a 10 gauge needle; this was followed by gentle débridement with files and reamers. A paper point with the Mixase A solution was sealed in the canal with zinc oxyphosphate cement. In seventy-two hours another culture was taken and the canal was prepared for filling and irrigated with the solution, and an enzyme point was sealed in. Seventy-two hours later the canal was filled.

The patients complained of burning discomfort when the canal was sealed with enzyme. There were two negative cultures in all cases. Débridement of bacterial substrate may account for this, as suggested by Auslander and Roth.[12] In this instance, however, the antibiotic neomycin was also sealed in the canals. It appears, therefore, that the combined enzyme-antibiotic preparations offer a useful therapy for necrotic root canals. Further investigation of this form of treatment certainly is indicated.

DISCUSSION

The treatment of oral diseases characterized by infection, necrosis, and fibropurulent exudate with proteolytic enzyme-antibiotic preparations is rational. Crystallized trypsin or trypsin as the principal enzyme in Mixase A rapidly hydrolyzes denatured protein arising in injured cells and intercellular structures. The antibiotics bacitracin and neomycin are effective in a wide microorganismal spectrum.

The observations of reduced necrotic debris, granulation tissue, reduction in the surface area, and early resolution of the lesions suggests local anti-inflammatory activity. One natural function of polymorphonuclear leukocytes is the phagocytosis of denatured protein and intracellular trypsinlike digestion. The large numbers of such cells on the surfaces of oral lesions suggest a defense mechanism as a function of proteolysis. The addition of exogenous trypsin to the surfaces of fibrinopurulent lesions should aid in the natural defense. This could serve to reduce the numbers of polymorphonuclear leukocytes attracted to surfaces, which tends to resolve the inflammatory process. The fibrin component of surface exudates serves to cover lesions as epithelization proceeds through and beneath it. Fibrin must be removed to resolve inflammation, as it may act as an irritant. Such fibrin may be phagocytized by polymorphonuclear leukocytes and histiocytes. Exogenous trypsin also digests fibrin.

The presence of antiproteolytic enzymes in exudate and the natural resistance of native protein to enzymes serves to limit topically applied trypsin to surface activities. Resolution of the deeper inflammatory process is a function of cells and exudate.

The antibiotic activity of enzyme-antibiotic preparations serves to kill most of the microorganisms found in oral lesions. This, in addition to removal of bacterial substrate by the enzyme, would serve to promote resolution of the inflammatory process.

The rate of healing in oral lesions is interdependent upon the production of irritants and of cellular exudate. The process of healing, although concurrent with inflammation, is independent of it. Enzyme-antibiotic preparations could serve to modify the rate of healing by the removal of irritants.

The observation of the usefulness of a single preparation in the treatment of various oral lesions indicates the similarity in the nature of the lesions. Surgical wounds, ulceronecrotizing gingivitis, acute alveolar osteitis, oroantral fistula, and necrotic pulps that present infection, necrosis, and fibrinopurulent exudate are uniformly amenable to therapy with topically applied enzyme-antibiotic preparations.

SUMMARY

The usefulness of enzyme-antibiotic preparations on necrotic, infectious, and fibrinopurulent lesions of the oral cavity was observed. Eighty cases of gingivectomy, eighteen cases of acute alveolar osteitis, seven cases of intra-alveolar pockets, four cases of acute ulceronecrotizing gingivitis, four cases of immediate denture surgery, three cases of soft-tissue trims of the ridge, one case of oroantral fistula, and three cases of necrotic pulps were treated. The enzymes trypsin and Mixase A were combined independently with various combinations of neomycin, polymyxin B, and bacitracin in either ointment or powder form.

The preparations were applied topically in all cases. When surgical dressings were used, the preparation of enzyme-antibiotics was incorporated. In such cases the dressings were applied about ten minutes after the topical application.

CONCLUSIONS

The variety of oral lesions treated had in common necrotic debris, infection, and fibrinopurulent exudate. The enzyme-antibiotic preparations in various combinations applied topically débrided all such lesions, reduced bacterial infection, induced resolution of inflammation, and accelerated the rate of healing.

REFERENCES

1. Dragstedt, C. A.: Digestion of Living Tissues by Proteolytic Enzymes, Science **98**: 131, 1943.

6. Stucke, K.: Digestion of Slough by Pancreatic Ferment in Treating Severe Burns, Chirurg. **20**: 588, 1949.
7. Horowitz: Textbook of Biochemistry.
8. Husfeldt, E.: Proteolytic Enzyme in Leucocytes, Ztschr. f. physiol. Chem. **194**: 137, 1931.
9. Menkin, Valy: Newer Concepts of Inflammation, Springfield, Ill., 1950, Charles C Thomas.
10. Opie, E. L.: Intracellular Digestion, Physiol. Rev. **2**: 552, 1922.
11. Jenkins, B. H., and Howell, J. H., Jr.: New Concept in Management of Severe Burns, Presented Before Georgia State Medical Society, 1957.
12. Reiser, H. G., Patton, R., and Roettig, L. C.: Tryptic Débridement of Necrotic Tissue, A. M. A. Arch. Surg. **63**: 568, 1951.
13. Miller, J. M., Peirce, E. C., II, and White, B. H.: The Clinical Use of Trypsin, Mil. Surgeon **113**: 270, 1953.
14. Miller, J. M., White, B. H., and Long, P. H.: Clinical Experience With Tryptar in the Treatment of Infected Wounds, Postgrad. Med. **13**: 438, 1953.
15. Madden, J. F.: Tryptar in Enzymatic Débridement of Indolent Infected Cutaneous Ulcers, M. Clin. North America **38**: 359, 1954.
16. Auslander, W. P., and Roth, H.: Tryptar—Its Application in Endodontics, ORAL SURG., ORAL MED. & ORAL PATH. **6**: 898, 1953.
17. Anderson, M. F.: A Report on the Use of Crystalline Trypsin in Treatment of Alveolar Osteitis, ORAL SURG., ORAL MED. & ORAL PATH. **10**: 1166, 1958.
18. Spiegel, L. H.: Proteolytic Enzymes an Aid in Treatment of Refractory Dry Sockets, ORAL SURG., ORAL MED. & ORAL PATH. **11**: 692, 1958.

ORAL ROENTGENOLOGY

American Academy of Oral Roentgenology

Arthur H. Wuehrmann, Editor

SIMPLIFYING AND IMPROVING INTRAORAL DENTAL ROENTGENOGRAPHY

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THE bisecting-angle technique is the best known and most widely used procedure for taking periapical roentgenograms in dental offices today. Its name describes the method followed for determining the vertical angulation of the x-ray beam and is based on the principle of directing the rays perpendicularly to an imaginary plane which bisects the long axes of the teeth and the plane of the film (Fig. 1).

This geometric principle must be followed if longitudinal or linear distortion is to be avoided. If the rays are directed perpendicularly to the long axes of the teeth (underangulation), the image will appear elongated. On the other hand, if the rays are directed perpendicularly to the film (overangulation), foreshortening of the image will result. Since it is difficult and often impossible to determine accurately the position of the bisecting plane, the technique relies greatly on the experience of the operator. Approximate angles based on the head position of the patient are used to overcome the guesswork of angulation, but, at best, this technique lacks accuracy and consistency.

Roentgenograms produced by this technique are accepted as anatomically accurate. Unfortunately, this is a false assumption, since another form of distortion is always present, a distortion which results from projecting three-dimensional objects (alveolar-dental structures) on a two-dimensional surface (the film). This is known as dimensional distortion and is not generally recognized. If it is recognized, it is accepted as unavoidable.

DIMENSIONAL DISTORTION

Dimensional distortion occurs when an angular relationship is created between the object and the film, as in the bisecting-angle technique (Fig. 2, *A*).

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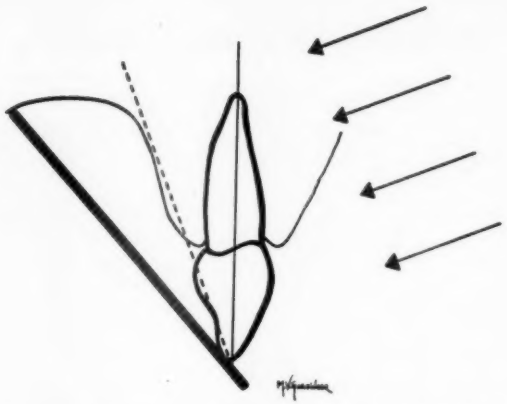
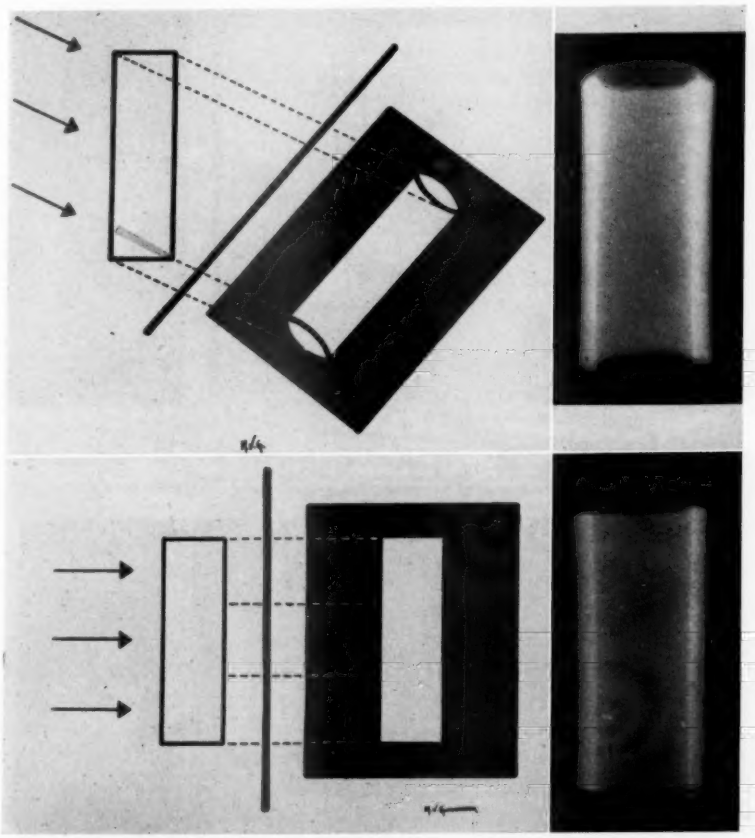


Fig. 1.—Bisecting-angle technique. Rays (arrows) directed perpendicularly to imaginary plane (dotted line) bisecting plane of tooth and plane of film.

A.

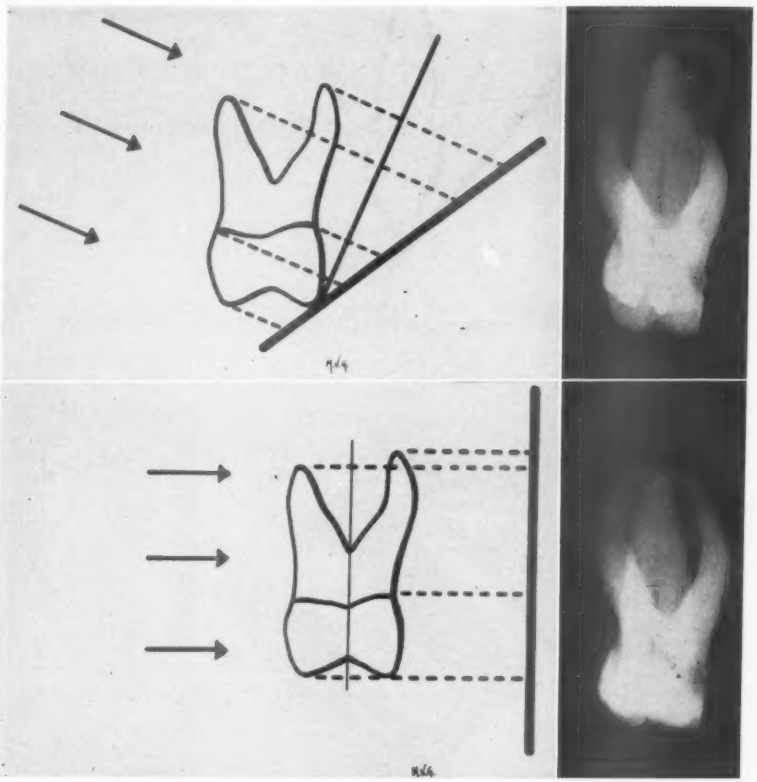


B.

Fig. 2.—*A*, Dimensional distortion resulting from bisecting-angle technique. (*Note:* Parts of object farther from film are projected lower on film than are the closer parts.)

B, Dimensional distortion minimized by paralleling the film with the object and directing the rays perpendicularly to both.

A.



B.

Fig. 3.—*A*, Bisecting-angle technique with resultant dimensional distortion. *B*, Paralleling technique with dimensional distortion minimized.

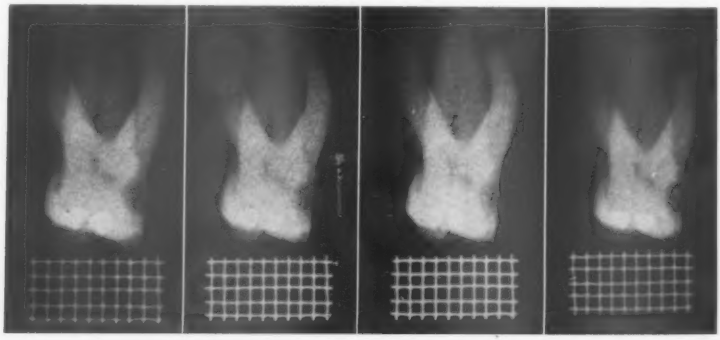


Fig. 4.—Progressive reduction in enlargement as the focal-film distance is increased. *Factors:* Object-film distance = 1½ inches; target-film distance (left to right) = 8, 16, 20, and 24 inches.

The parts of the object farther away from the film are projected in an incorrect relationship to the parts closer to the film, and an image which does not accurately represent the object is produced. Such inaccuracy can be overcome by positioning the film parallel to the object and directing the rays perpendicularly to the film and object (Fig. 2, *B*). The dimensional distortion is now minimized, since all parts of the object are projected in their true relationship to each other.

Applying the foregoing observations to dental roentgenography, Fig. 3, *A* demonstrates dimensional distortion resulting when the bisecting-angle technique is used for x-raying the three-dimensional structures of a maxillary molar. Since objects farther from the film manifest a proportionately greater effect of angulation than objects adjacent to the film, the buccal roots are projected proportionately lower on the film than the lingual root; hence, the abnormal foreshortened appearance of the buccal roots. The same observation can be made of the cementoenamel junction of the buccal and lingual surfaces and of the buccal and lingual cusps of the molar.

When the film is paralleled with the molar (Fig. 3, *B*), the buccal roots are projected in their true anatomic relationship to the lingual root and the entire image appears free from dimensional distortion.

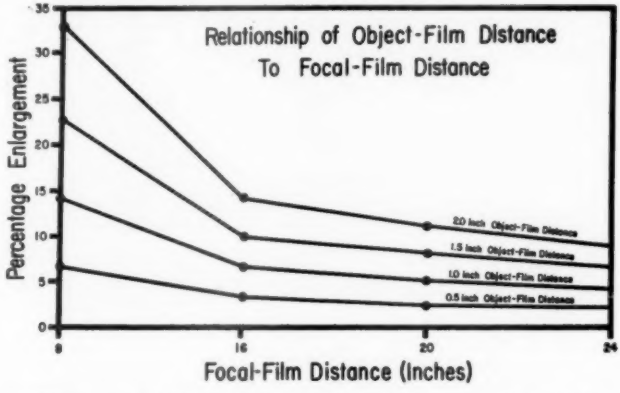


Fig. 5.—Effect of focal-film, object-film relationship on percentage of image enlargement.

In dental roentgenography, the anatomic structures usually make it necessary to create a distance between the film and the teeth when a paralleling relationship is attempted. This is particularly true in the maxilla. Such an increase in object-film distance will produce an enlargement of the image when the conventional short cone (8 inches) focal-film distance is used. This enlargement can be overcome, however, by doubling the focal-film distance to 16 inches or more (Fig. 4).

The graph in Fig. 5 depicts the relationship of focal-film distance to object-film distance. From this, it can be seen that the greatest reduction of enlargement takes place when the focal-film distance is increased from 8 inches (the

distance commonly used with the bisecting-angle technique) to 16 inches. Beyond the 16 inch focal-film distance, the reduction in image enlargement becomes much less, while the difficulties of positioning the x-ray head become greater. For practical purposes, therefore, the 16 inch focal-film distance is recommended for general use with the paralleling technique. However, if a greater focal-film distance can be satisfactorily adapted to the local situation, it should be the one of choice.

A more detailed description of the relationship between object-film distance and focal-film distance in image production in roentgenography can be found elsewhere.[1-7]

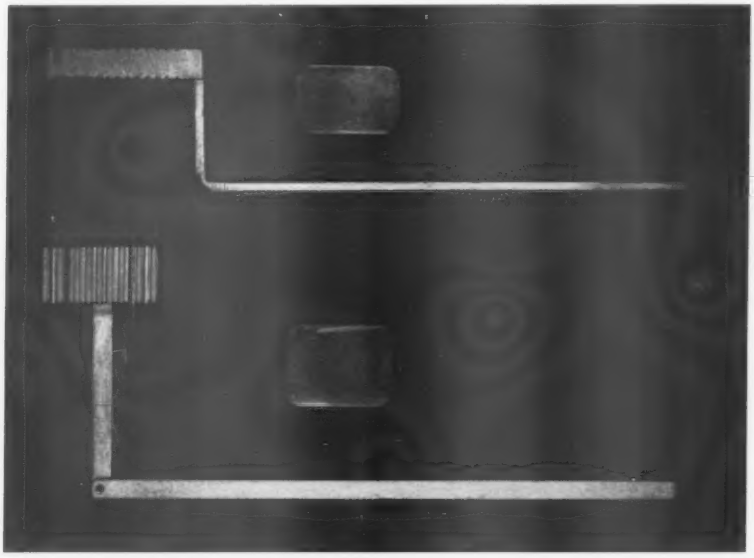


Fig. 6.—Plastic instruments designed to maintain a parallel tooth-film relationship and indicate the alignment of the x-ray tube.
Top: Instrument and metal backing for anterior teeth.
Bottom: Instrument and metal backing for posterior teeth.

PARALLELISM AND ANGULATION

The most common problem encountered in the paralleling technique is the proper placement and retention of the film. The objectives are to position the film as nearly parallel to the teeth as the anatomy will allow, maintain a flat film plane at all times, hold it in that position until the tube is properly adjusted and the exposure completed, and accomplish these as simply and quickly as possible.

The next problem is to establish the correct angulation, both vertically and horizontally, and to direct the central rays to strike the center of the film. This, too, must be done quickly and easily.

These two problems can be readily solved by utilizing a set of instruments which is designed to position the film as parallel as possible to the teeth and, at the same time, indicate the alignment of the extension tube which will establish a perpendicular relationship between the rays and the film. This eliminates the need for specific angulation settings for each area and also the necessity for positive head positions for each jaw.

The set (Fig. 6) consists of two instruments constructed of a cured plastic material—one for the anterior teeth and the other for the posterior teeth. Each is basically a specially constructed bite block which enables the operator to attain a maximal parallel relationship between the film and the teeth being examined. Extending from the bite block is a rod which positively indicates the alignment for the extension tube of the x-ray unit which, when properly positioned, assures the operator that the central rays are being directed perpendicularly to the film.

TECHNIQUE

Description of the technique will be limited to four general areas—maxillary anterior and posterior and mandibular anterior and posterior. From this description, the necessary modifications can readily be made for additional studies within each region.

It will be noted that no description of head position is given; nor is the angulation of the tube suggested. Neither is necessary as long as the film-teeth relationship is parallel and the tube is directed along the indicator rod for the center of the film.

Maxillary Anterior Technique (Fig. 7).—

1. The film and backing plate are inserted on their long axes in the slot of the anterior holder.

2. The holder is inserted in the mouth, and the film is positioned well posteriorly and parallel with the long axes of the maxillary incisors.

3. With the holder resting on the incisal edges of the maxillary teeth, the patient retains it in position by closing the jaws firmly on a cotton roll which has been inserted between the mandibular incisors and the underside of the block. This ensures maximum stability (Fig. 7, *A*).

4. The extension tube of the x-ray unit is paralleled with the indicator rod of the holder, and the central rays are directed for the center of the film (Fig. 7, *B*). (*Note:* Specific head position and angulation are unnecessary, since alignment of the extension tube with indicator rod automatically assures correct positioning and angulation; Fig. 7, *C*.)

Maxillary Posterior Technique (Fig. 8).—

1. The film and backing plate are inserted in the proper slot of the posterior holder (the deep slot for low vaults, the shallow slot for high vaults).

2. The indicator rod is turned at right angles to the portion extending from the bite block toward the side being examined.

3. The film is positioned in the mouth parallel with the long axes of the teeth being x-rayed. This usually locates the film in the midline of the palate (Fig. 8, *A*).

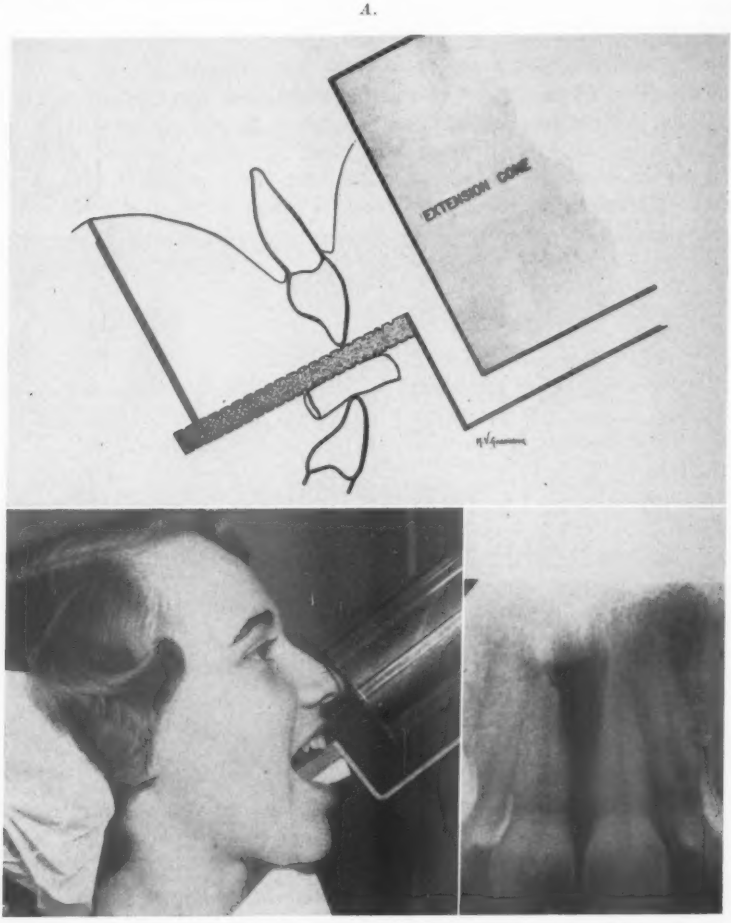
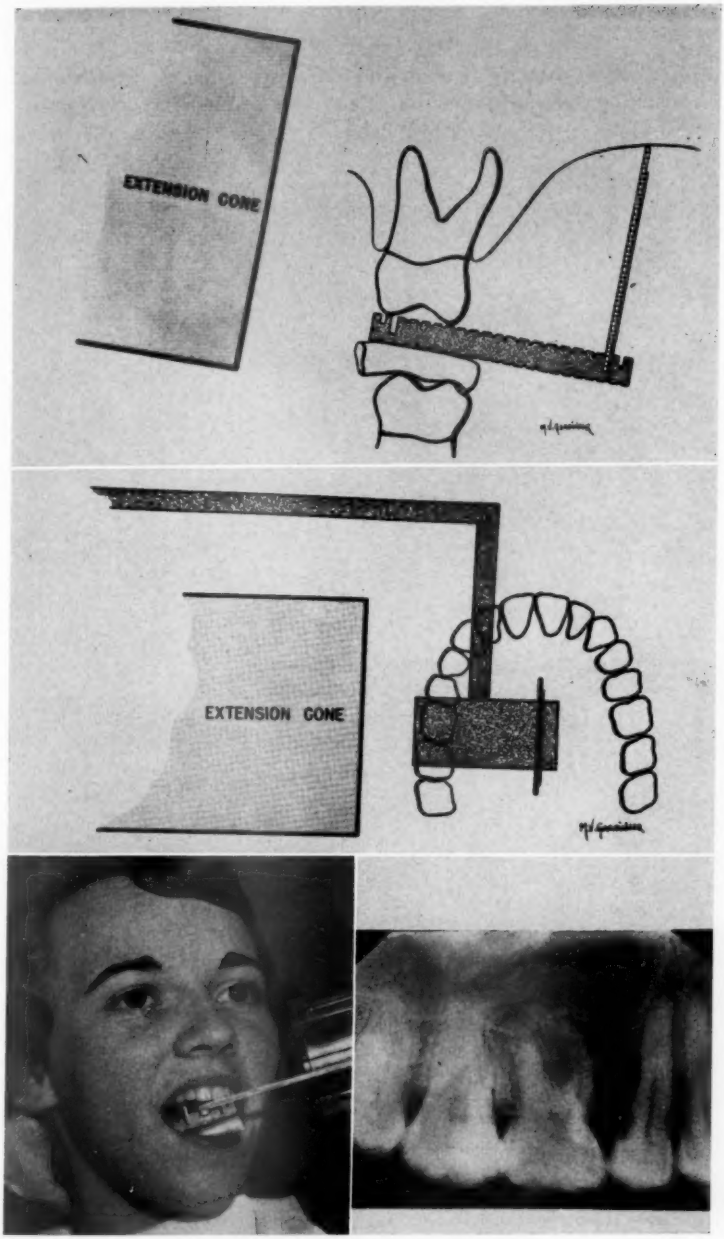


Fig. 7.—Maxillary anterior technique.
A, Note object-film distance created when film-tooth parallelism is attained.
B, Note cotton roll on underside of block for stability.
C, Resultant roentgenogram.

4. The patient retains the holder-angulator in place by closing the mouth firmly on a cotton roll inserted between the mandibular teeth and the undersurface of the block (Fig. 8, *A*).

5. The extension tube of the x-ray unit is paralleled with the indicator rod, and the rays are directed for the center of the film (Fig. 8, *B* and *C*). (*Note:* When absolute parallelism between the film and the teeth is impossible due to



A.

B.

C.

D.

Fig. 8.—Maxillary posterior technique.

A, Posterior aspect; note that film is positioned in area of midline of palate.

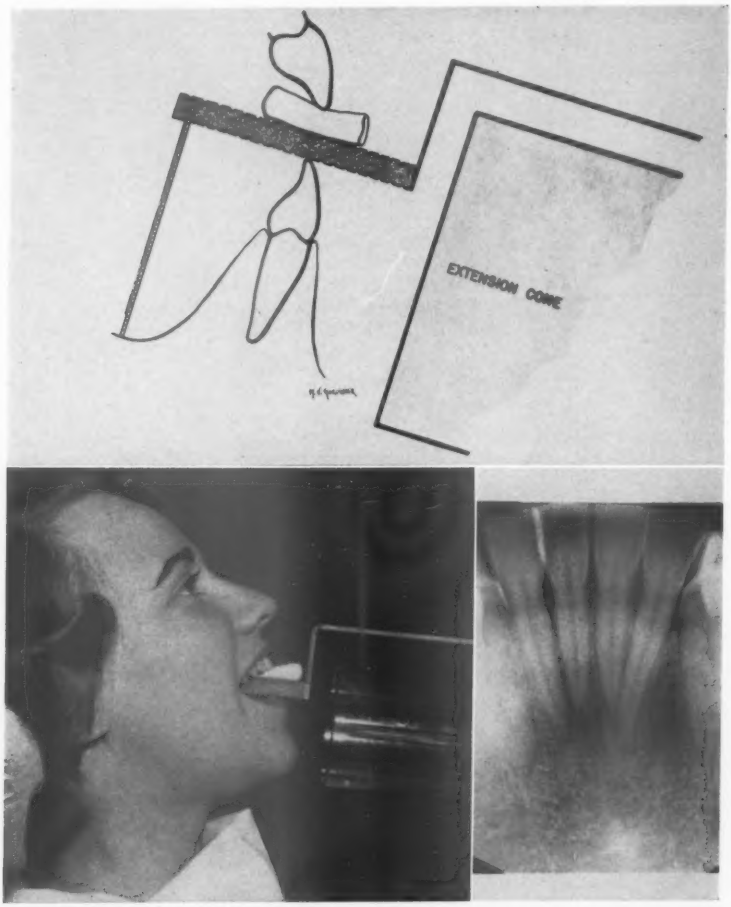
B, Superior aspect; note horizontal relationship of extension cone to instrument.

C, Anterior aspect; note that perpendicularity of rays to film is assured with this extension cone instrument alignment.

D, Resultant roentgenogram.

anatomic limitations, the vertical angulation can be reduced proportionately. The authentic anatomic reproduction of the area is seen in the roentgenogram in Fig. 8, *D*.)

A.



B. *C*.

Fig. 9.—Mandibular anterior technique.

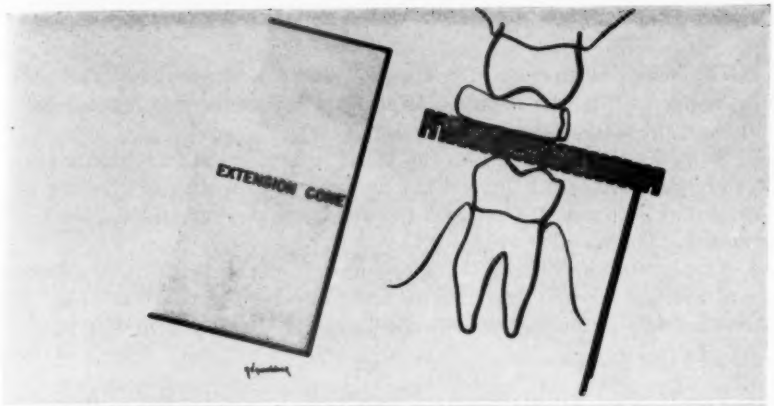
A, Note that parallel film-tooth relationship permits a shorter object-film distance than in the corresponding maxillary region.

B, Note cotton roll on upper side of block for stability.

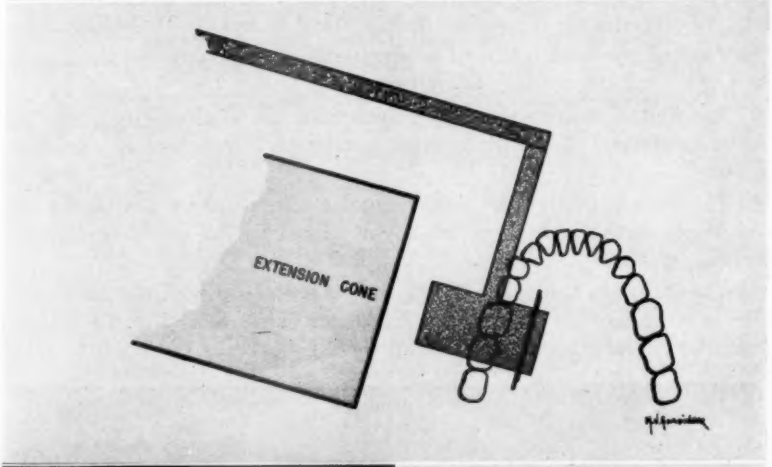
C, Resultant roentgenogram.

Mandibular Anterior Technique (Fig. 9).—

1. The film and backing plate are inserted on their long axes in the slot of the anterior holder.



A.



B.

C.

D.

Fig. 10.—Mandibular posterior technique.

A, Posterior aspect; note that when the film is paralleled with the teeth, a positive (caudad) angulation of the rays is usually indicated.

B, Superior aspect; note horizontal relationship of extension cone to instrument.

C, Anterior aspect; note alignment of extension cone with indicator rod.

D, Resultant roentgenogram.

2. The holder is inserted in the mouth, and the film is positioned parallel with the long axes of the mandibular incisors. The distance created between the film and the teeth is disregarded.

3. With the holder resting on the incisal edges of the mandibular anterior teeth, the patient retains it in position by closing the mouth firmly on a cotton roll which has been inserted between the maxillary incisors and the block. This insures maximum stability (Fig. 9, *A*).

4. The extension tube of the x-ray unit is paralleled with the indicator rod, and the central rays are directed for the center of the film (Fig. 9, *B*). This relationship guarantees an accurate image production (Fig. 9, *C*).

Mandibular Posterior Technique (Fig. 10).—

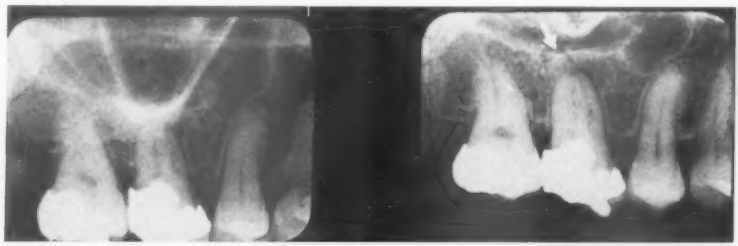
1. The film and backing plate are inserted in the proper slot of the posterior holder (the deep slot for the shallow sulcus, the shallow slot for the deep sulcus).

2. The indicator rod is turned at right angles to the portion extending from the bite block toward the side being examined.

3. The film is positioned in the sulcus with the block resting flatly across the occlusal surfaces of the teeth being examined. Parallelism is thus attained (Fig. 10, *A*).

4. The patient retains the holder-angulator in place by closing the maxillary posterior teeth firmly on a cotton roll placed on the upper surface of the block (Fig. 10, *A*).

5. The extension tube of the x-ray unit is paralleled with the indicator rod, and the central rays are directed for the center of the film (Fig. 10, *B* and *C*). The resultant roentgenogram is seen in Fig. 10, *D*.



A. *B.*

Fig. 11.—*A*, Bisecting-angle, short-distance technique.
B, Paralleling, extended-distance technique.

The above-described technique not only reduces the guesswork in intraoral roentgenography, thus eliminating the necessity for retakes, but it also produces roentgenograms with greater anatomic integrity and superior interpretive qualities. Comparison of films taken by the paralleling, extended-distance technique with those taken by the bisecting-angle, short-distance technique will prove these statements. A roentgenogram of the maxillary molar region made by the bisecting-angle technique is shown in Fig. 11, *A*. In this roentgenogram, the following may be noted:

1. The zygomatic shadow obscures the roots of the first molar, which show some indication of pathosis.

2. The buccal roots are foreshortened in comparison to the lingual root.

3. The interproximal bone appears indistinct with characteristics of resorption.

4. The entire trabecular pattern lacks good detail.

5. The buccal cusps are projected beyond the lingual cusps.

The roentgenogram seen in Fig. 11, *B*, made by the paralleling technique, reveals the following improvements:

1. The zygomatic shadow is demagnified and projected well above the roots of the first molar, making positive the interpretation of a periapical roentgenolucency associated not only with the mesiobuccal root but with the lingual root as well.

2. The size of the buccal roots appears more normal in relationship to the lingual root.

3. The level of the interproximal bone is positively established with no evidence of pathosis.

4. Trabecular detail is improved.

5. The buccal and lingual cusps are projected in their normal relationship.

SUMMARY

1. The conventional bisecting-angle, short-distance technique used for intraoral roentgenographic examinations results in dimensional distortion. This can be eliminated by using the paralleling, extended-distance technique.

2. Instruments to facilitate placement of the film in a parallel relationship to the teeth and at the same time indicate the alignment of the extension tube are described.

3. These instruments eliminate mechanical angulation and specific head positioning and standardize the procedure. Such standardization makes possible an accurate comparison of postoperative roentgenograms with those made preoperatively.

CONCLUSIONS

A standardized procedure for intraoral roentgenography which will produce uniform films possessing anatomic accuracy and geometric clarity has been presented. It is hoped that such simplification of film positioning and tube direction will encourage many to adopt this method for producing roentgenograms of superior interpretive quality.

REFERENCES

1. McCormack, F. W.: A Plea for Standardized Technique for Oral Radiography, J. D. Res. 2: 467, 1920.

2. Fitzgerald, Gordon M.: Dental Roentgenography. I. An Investigation in Adumbration, J. Am. Dent. A. 34: 1, 1947.
3. Richards, Albert G.: Roentgenographic Techniques Made to Order, J. Am. Dent. A. 39: 396, 1949.
4. Waggener, Donald T.: Principles of the Long Tube Technique, J. Nebraska Dent. A. 24: 3, 1947.
5. Sweet, A. P. S.: Peripheral Geometry in Radiodontics, D. Radiog. & Photog. 25: 14, 195[illegible].
6. Files, G. W.: Medical Radiographic Technique (G. E. X-ray Corp.), Springfield, Ill. 1954, Charles C Thomas.
7. Updegrave, W. J.: Paralleling Extension-Cone Technique in Intraoral Dental Radiography, Oral. Surg., Oral Med. & Oral Path. 4: 1250, 1951.

ACCURACY OF X-RAY TIMERS

A Trial Investigation

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IN DENTAL roentgenography it is of mutual benefit to the patient and the dentist to use the minimum amount of radiation capable of producing roentgenograms with maximum interpretive qualities. Inserting filtration, collimating the beam, increasing kilovoltage, processing in a high-energy developer, and using higher-speed film are proved methods that accomplish this purpose. Any or all of these procedures will reduce materially the amount of radiation reaching the patient's tissues without greatly affecting the quality of the finished roentgenogram, provided that the operator understands the application of each and properly incorporates them into his technique.

Radiation reaching the patient can be greatly reduced by decreasing the exposure time. This is accomplished by using film with a higher emulsion speed. The faster film, however, is not always satisfactory, since the resultant roentgenograms are sometimes inferior in quality and exhibit variance in their densities. The primary reasons for this can be traced to two sources—(1) fog and (2) inadequacy of x-ray timers.

It is an established fact that the margin for error becomes smaller as the speed of the film emulsion is increased. When minor errors of under- or overexposure and under- or overdevelopment occur, the interpretive quality of the finished roentgenogram is not too greatly affected when slow-speed film is used. However, these same errors may produce a roentgenogram of little interpretive value when a high-speed film technique is used. The importance of accurate exposures and controlled developing procedures cannot be overemphasized.

The faster film is also more sensitive to fogging, especially to radiation and light fog; thus, protection against scattered radiation during exposure becomes more critical with the faster-emulsion film. Processing-room facilities that were satisfactory for the slower films may fog the faster films. The control of film fog has been the subject of previously published material.[1]

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A crucial question that must be answered centers around the ability of the timers on dental x-ray units to produce accurate exposures as short as those recommended by the film manufacturers (Chart 1).

REGION	EXPOSURE TIME (SECONDS) 65 KV., 10 MA., 8 INCH TARGET-FILM DISTANCE			
	EASTMAN KODAK ULTRA-SPEED	DU PONT	RINN EF	MINIMAX EF
Maxillary				
Molar	3/8	Recommended for 16 inch and 20 inch target-film distances only	1¼-1½	1
Premolar	¼		¾-1	¾
Cuspid	2/10		¾	⅝
Incisor	¼		¾	¾
Mandibular				
Molar	¼		¾-1	¾
Premolar	2/10		½-¾	⅝
Cuspid	2/10		½	⅝
Incisor	2/10		½	½

Chart 1.—Exposure times recommended by four manufacturers of dental x-ray film.

Since the majority of x-ray units in dental offices operate with spring-type timers, their accuracy for fractional-second exposures was questioned. Therefore, it was decided that a representative number of dental x-ray timers in the offices of dentists in the Philadelphia area should be surveyed.

METHOD

A spinning top was used to check the accuracy of the timers for exposures of less than one second. This testing device consisted of a small 60-cycle electric motor, to the shaft of which was attached an aluminum disk, mounted horizontally and recessed to receive an occlusal film. When the motor was energized, the disk and film made a complete revolution every second. The entire assembly was housed in a container with a hinged, leaded lid into which was cut a small opening. When this device was positioned with the opening in the lid directly beneath the cone of the x-ray unit and the motor was energized, an exposure was recorded through the opening onto the film, leaving small roentgenolucent images representing the fractional-second exposures.

TABLE I

Number of dental x-ray units examined	53
1. Timers considered accurate (timers which produced fifteen, thirty, and forty-five images for one-fourth, one-half, and three-fourths second, respectively)	8 (15%)
2. Fast timers (timers which produced less than fifteen, thirty, and forty-five images for one-fourth, one-half, and three-fourths second, respectively)	29 (55%)
Result	Underexposure
3. Slow timers (timers which produced more than fifteen, thirty, and forty-five images for one-fourth, one-half, and three-fourths second, respectively)	16 (30%)
Result	Overexposure

Since an accurate exposure of one-fourth second produced fifteen images, an exposure of one-half second produced thirty images, and an exposure of three-fourths second produced forty-five images, a comparison of the number of images with the exposure time determined the accuracy of the timers tested. The results of the survey are seen in Table I and Figs. 1, 2, and 3.

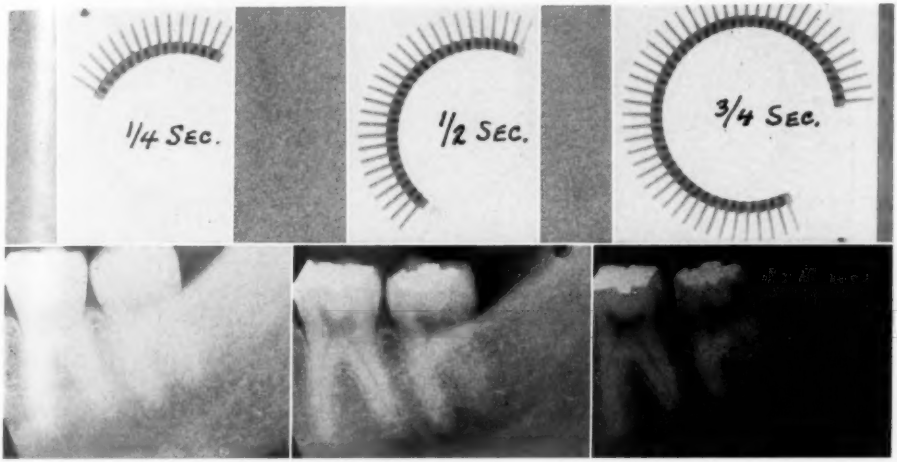


Fig. 1.—*Top row:* Roentgenographic images of spinning top produced with "accurate" timer. One-fourth second, 15 images; one-half second, 30 images; three-fourths second, 45 images.

Bottom row: Resultant roentgenograms. Ultra-Speed film, 65 kv., 10 Ma., 8 inch target-film distance.

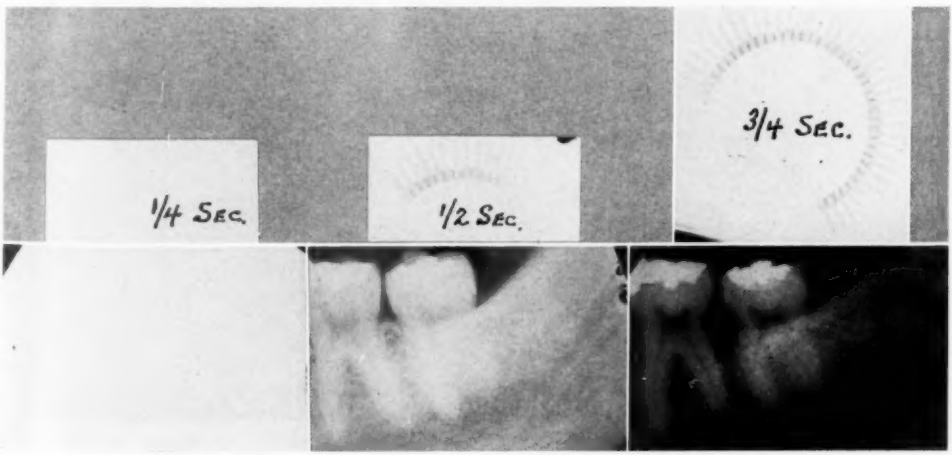


Fig. 2.—*Top row:* Roentgenographic images of spinning top produced with "fast" timer. One-fourth second, no image; one-half second, 13 images; three-fourths second, 40 images.

Bottom row: Resultant roentgenograms. Ultra-Speed film, 65 kv., 10 Ma., 8 inch target-film distance.

The results shown in Table I indicate that 85 per cent of the timers of units examined were inaccurate. Of this 85 per cent, approximately two-thirds of the timers were fast. This means that less radiation was being produced than the timer indicated in two-thirds of the units, while the remaining one-third of the units produced more radiation than anticipated.

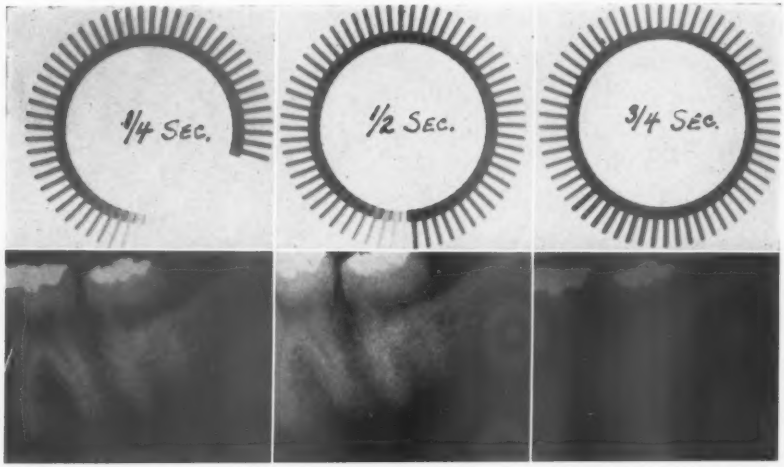
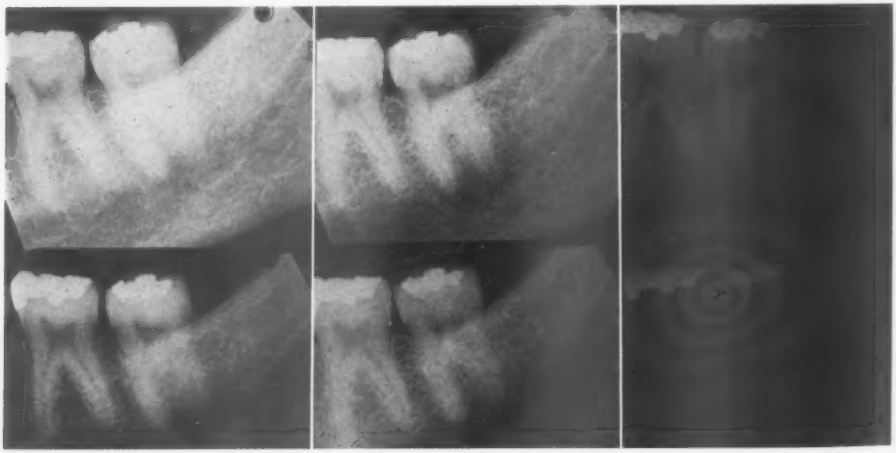


Fig. 3.—*Top row:* Roentgenographic images of spinning top produced with "slow" timer. One-fourth second, 49 images; one-half second, 65 images; three-fourths second, 71 images.
Bottom row: Resultant roentgenograms. Ultra-Speed film, 65 kv., 10 Ma., 8 inch target-film distance.



A. *B.* *C.*

Fig. 4.—Exposures made with medium-speed (Radiatized) film.
Top row: One and one-half seconds, 10 Ma., 65 kv., 8 inch target-film distance.
Bottom row: Two seconds, 10 Ma., 65 kv., 8 inch target-film distance. *A*, Fast timer; *B*, accurate timer; *C*, slow timer.

A. *B.* *C.* *D.*

Fig. 5.—Results of reduction in milliamperage when "slow" timer is used with Ultra-Speed film, 65 kv., 8 inch target-film distance.

A, 10 Ma., one-fourth second; *B*, 5 Ma., one-fourth second; *C*, 5 Ma., one-half second; *D*, 5 Ma., three-fourths second.

These same timers, when operating with slower films, produced more uniform results since the percentage of error decreased with the longer exposures. This can be seen in the radiatized films for which an exposure time of one and one-half seconds is recommended (Fig. 4). A 10 per cent error in a timer would have little effect on the density of a lower-speed film, but that same error becomes more apparent when a fractional-second exposure is used with fast film. This is seen in the one-fourth-second exposures made on Eastman Ultra-Speed film (Figs. 1, *A*, 2, *A*, and 3, *A*).

Five of the newly manufactured 90 KVP dental x-ray units were examined and found to have timers with high accuracy at all fractional-second exposures. This does not mean that the use of higher-speed film at an 8 inch target-film distance is limited to the new dental x-ray units. If the timer is "fast" (Fig. 2), it is probable that a longer exposure than the manufacturer recommended could be used. If the timer is "slow" (Fig. 3), it may be necessary to use a lower-speed film at the 8 inch target-film distance, or, if the high-speed film is used, the milliamperage can be lowered from 10 Ma. (the usual operating level) to 5 Ma. Since the density of a film is controlled primarily by milliampere seconds (milliamperage × seconds of exposure), the reduction in milliamperage compensates for the inaccuracy of the timer (Fig. 5).

SUMMARY

1. The use of a minimum amount of radiation in producing films of maximum interpretive quality should be the objective of all dental roentgenographic procedures.

2. High-speed emulsion films definitely reduce radiation. Fog and inadequacy of x-ray timers are problems encountered when high-speed films are used.

3. This investigation disclosed inaccuracy for fractional-second exposures in 85 per cent of the timers examined. Compensation for this inaccuracy can be made by altering the exposure time or by decreasing the milliamperage.

CONCLUSION

High-speed emulsion films can be used satisfactorily with the 8 inch target-film distance. Certain modifications may be necessary to compensate for the inadequacy of timers. In addition, careful handling of the films during exposure and processing will produce roentgenograms of the quality desired.

REFERENCE

1. Sweet, A. P. S.: Fog on Films, J. Am. Dent. A. 51: 673-679, 1955.

ORAL PATHOLOGY

EXCESSIVE FORMATION OF CEMENTUM TOWARD THE FOLLICLE OF AN EMBEDDED MOLAR

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THE relationship of the enamel and cementum at the cementoenamel junction is not always the same in all teeth. Hopewell-Smith, as cited by Schour,[1] found that in about 60 to 65 per cent of the cases, the cementum overlaps a small portion of the gingival enamel; in 30 per cent of the cases, the enamel and cementum meet end to end; and in about 5 to 10 per cent of the cases, the enamel and cementum do not touch each other, and thus a small portion of the dentinal surface is exposed. We have observed that in most cases the cementum in the cementoenamel junction is primary cementum or acellular cementum. Boyle[2] described the various types of the so-called coronal cementum, and all of them were found in contact with the enamel.

He mentioned the common occurrence of cementum extended "over the crown," which he called "cementum spurs." I am not sure whether these cementum spurs are the same as the cementum overlapping the enamel at the cementoenamel junction which constitutes about 60 to 65 per cent of the cases. This report will deal with a case of excessive formation of cementum toward the follicle of an embedded molar and not in contact with the surface of the enamel. The cementum formed is of the secondary or cellular cementum. Canals in the cementum containing blood vessels were also observed in many of the histologic sections.

CASE REPORT

A patient was seen complaining of persistent headache of more than a year's duration. He had been under the care of a physician for some time, and it seemed that the cause of the headache could not be definitely determined. The patient was referred to a dentist who, in turn, referred the patient to me for consultation. Fig. 1 shows one of the dental roentgenograms in which may be seen an embedded upper third molar more

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or less in buccoversion. It may be noted in the roentgenogram that, besides the surrounding bone, there is an unusual structure marked *c*, evidently surrounding the distal portion of the crown of the tooth. The tooth was removed surgically and decalcified sections were made of the specimen.

Fig. 1.—Radiograph in the upper left molar region. Note the embedded upper third molar, which is more or less in buccoversion, and the unusual structure marked *c* partially surrounding the crown of the tooth.

Fig. 2 shows a section in which may be seen active formation of secondary cementum into the follicle of the embedded molar. It may be noted that a row of cementoblasts, marked *a*, is at present actively forming cementum. The cementoid is quite prominent between the cementoblasts and the already formed cementum. A portion of the primary

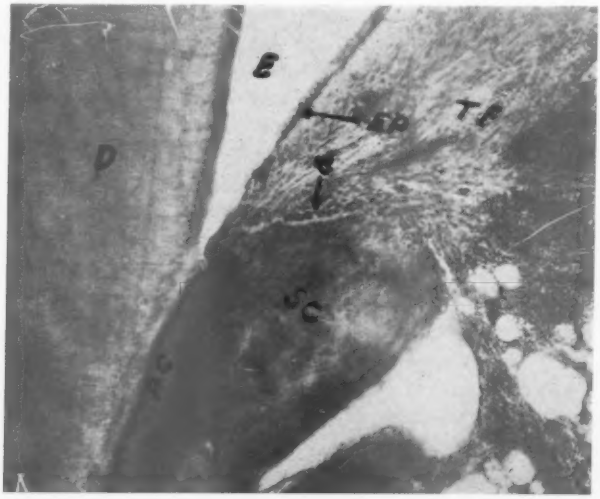

Fig. 2.—A decalcified section of the embedded third molar showing the excessive formation of secondary cementum (*SC*). Note a row of cementoblasts marked *a*. *D*, Dentine; *PC*, primary cementum; *E*, space formerly occupied by the enamel; *EP*, reduced enamel epithelium; *TF*, tooth follicle.

or acellular cementum, marked *PC*, covering the dentinal surface is also present. Fig. 3 shows another portion of the specimen in which excessive formation of secondary cementum toward the follicle of the tooth may be seen. It may be noted that remnants of the follicle are still present, indicating that the cementum was not in contact with the enamel. A canal containing a blood vessel is also present in the cemetum. Fig. 4 shows another section in which the presence of excessive cementum, now near the enamel surface, is apparent. In fact, a portion of the cementum is already in contact with the

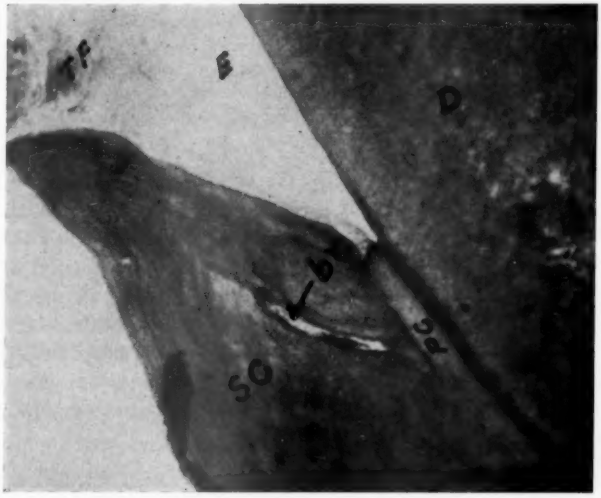

Fig. 3.—Another section showing excessive formation of cementum (*SC*). *TF*, Remnants of tooth follicle; *E*, space formerly occupied by the enamel; *D*, dentine; *PC*, primary cementum; *bv*, canal with blood vessel.

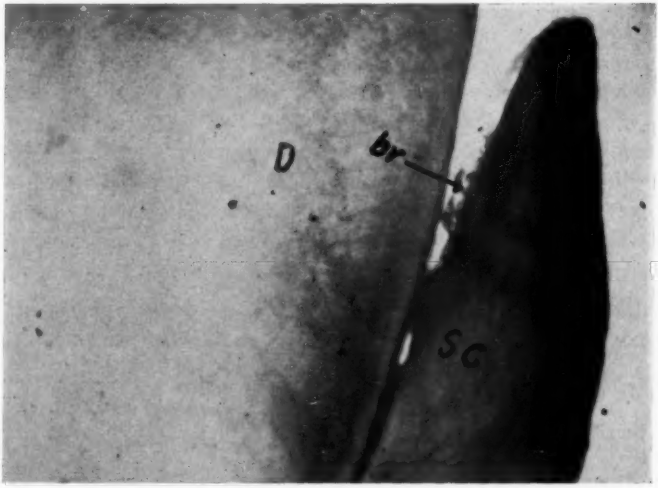

Fig. 4.—Another section showing excessive cementum (*SC*). *D*, Dentine; *bv*, remnant of a blood vessel with red cells.

surface of the enamel. A remnant of a blood vessel with red cells is present between the surface of the enamel and the cementum. It would seem as if, in the final termination of the cementum formation, the cementum will eventually be in contact with the enamel. If this happens, the whole of the cervical third of the crown of this particular tooth and possibly a portion of the middle third will be covered by a very thick cementum. From our stock of slides of decalcified and ground sections of teeth, this is the first time that we have observed unusual growth of cementum toward the follicle of the tooth. Most of the excessive cementum formations are observed in the apical region of the tooth.

COMMENT

This case may be considered an example of hyperplasia of the cementum in an unusual location. The majority of cementum hyperplasia is due to some kind of irritation. Cementum hyperplasia in the apical portion of the root of the tooth is often associated with a very mild infection in the apical region. We are unable to determine the etiological factor for this excessive cementum formation. It is interesting to note that there was some kind of relief from the patient's persistent headache after removal of the tooth, but it seems premature to make a definite statement. We are still following up the case.

REFERENCES

1. Schour, I.: Noyes' Oral Histology and Embryology, Philadelphia, 1953, Lea & Febiger, p. 113.
2. Boyle, P. E.: Kronfeld's Histopathology of the Teeth and Their Surrounding Structures, Philadelphia, 1955, Lea & Febiger, p. 267.

ABERRANT SALIVARY GLAND TISSUE IN MANDIBLE

Manawel Araiche, D.D.S., and Herbert Brode, D.D.S.,* Rochester, N. Y.*

A WHITE man, aged 55 years, was referred to the Oral Surgery Department of the Strong Memorial Hospital because of right mandibular pain.

Intraoral examination revealed that the patient was edentulous, with normal-appearing mucosa except for a white pinhead-sized lesion on the right mandibular buccal canine area. The patient was able to pinpoint the lesion as being the source of his pain.

Periapical and lateral-jaw roentgenograms revealed a translucent area at the superior surface of the mandible, extending from the right premolar region to the right central incisor region. There was no clear delineation of the lesion (Figs. 1 and 2). An excision biopsy was decided upon.

Operative Procedure.—Under block anesthesia, an incision 3.5 cm. long was made on the crest of the ridge overlying the lesion and the tissue was reflected. A window, 1 cm. in diameter, was made and a firm, spongy, lobulated tissue was visualized. A curette inserted behind the mass revealed that the lingual cortical plate was missing, as the floor of the mouth could be elevated. Since it was not possible to ascertain the posterior extension of the mass, it was decided to remove a piece 1 cm. in diameter for frozen section. Diffuse hemorrhage was encountered as soon as the specimen was removed; this was controlled by pressure. Gelfoam soaked in thrombin was packed in the defect, and the mucosal edges were approximated with 000 silk.

Postoperative Course.—Healing progressed uneventfully, although the patient did complain of sporadic mandibular pain which slowly regressed.

Pathology Report.—Minor salivary gland tissue and arteries, veins, and bone fragments from the mandible were studied pathologically.

Gross: The specimen received with the source of tissue designated as "mandible" consisted of a polypoid piece of tissue measuring 1.2 by 0.8 by 0.6 cm. It had a roughened surface with verruca-like projections on its surface, and a short 4 mm. stalk was present. On sectioning of this tissue, multiple

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firm white nodular areas were seen at the tip of the structure. The frozen section on this material disclosed many vascular channels but failed to reveal any neoplastic cells.

The specimen received in fixative (formalin) with the source of tissue designated as "mouth" consisted of six small fragments of pinkish white tissue, all of which contained pieces of bone. These fragments ranged in size from 1 by 0.4 by 0.3 cm. to 0.2 by 0.3 by 0.2 cm.

Fig. 1.

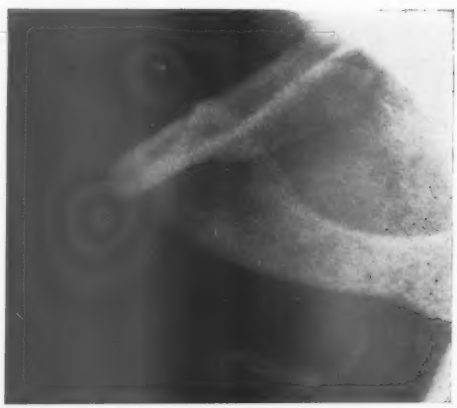

Fig. 2.

Microscopic: The sections revealed well-encapsulated mucous glands of the salivary type with surrounding fibrous and adipose tissue. Several medium-sized veins and two arteries were seen. In one area there were numerous spaces surrounded by blood clot. One section included fragments of cortical bone.

SUMMARY

A case of aberrant salivary gland in the mandible has been reported. It appears that there is no way to diagnose this condition except by biopsy.

Because of the paucity of literature on salivary gland tissue found within the mandible, this case has been reported. Only two other cases have been found in the literature.[1, 2]

REFERENCES

1. Thoma, Kurt H.: Oral Pathology, ed. 4, St. Louis, 1954, The C. V. Mosby Company, p. 1141.
2. Richard, E. L., and Ziskind, J.: Aberrant Salivary Gland Tissue in Mandible, ORAL SURG., ORAL MED. & ORAL PATH. 10: 1068-1090, 1957.

SUPERNUMERARY TEETH

Prof. S. Isokawa, Ph.D., D.D.S., and T. Ozaki, D.D.S., Tokyo, Japan

OF THE many dental anomalies, few are more interesting than supernumerary teeth. Recently two cases have been observed.

Fig. 1.

Fig. 2.

The first case, detected by Dr. T. Ozaki, was that of a 19-year-old boy who had five premolars in the premolar region of the lower jaw. Two of the right premolars in the lower jaw were impacted (Figs. 1 and 2).

From the Department of Anatomy, Tokyo University, Hongo, Tokyo, Japan.

Fig. 3.

A second case is that of a 20-year-old man who had two canines in the region of the upper left maxilla (Fig. 3). This case has already been reported in a Japanese publication.*

Presumably, these occurrences may be due merely to hyperactivity of the dental lamina.

*Nezu, F., and Uchida, Y.: A Rare Case of the Supernumerary Cuspid, Shikka Geppo 31: 20-23, 1958.

ENDODONTICS

The American Association of Endodontists

Victor H. Dietz, Editor

TREATMENT OF AN UNUSUAL PERFORATION OF AN ANTERIOR TOOTH

Report of a Case

Manuel I. Weisman, D.D.S., Augusta, Ga.

History and Local Findings.—The patient, a 52-year-old man, was referred to my office for endodontic therapy of the upper right lateral incisor. His referring dentist, in an effort to establish drainage of an acute abscess of the upper right lateral incisor, inadvertently, with a high-speed bur, penetrated not only the lingual aspect of the crown and the coronal pulp chamber but also the anterior aspect of the root, and the tip of the crest of the alveolar process and, in a superior anterior plane, perforated the mucous membrane (Fig. 1).

Upon close examination, it was possible to pass an instrument either through the abnormal channel created (Fig. 2) or through the normal root canal (Fig. 3).

Treatment.—Under local anesthesia, a "U"-shaped area of gingival tissue, including the opening of the tissue created by the bur, was removed. This revealed the clean-cut bur marks on the root surface and crest of bone (Fig. 4). The canal was temporarily closed off with a few gutta-percha cones, and a subgingival Class V type of preparation was placed in the perforated root. Amalgam was then condensed in the cavity, and the gutta-percha was removed (Fig. 5). The wound was then packed with Ward's Surgical Pack and the patient was dismissed (Fig. 6). Forty-eight hours later the pack was removed. The tissue was found to be healing normally, so it was decided to proceed with the routine endodontic treatment (Fig. 7). (The acute symptoms had subsided from the periapical condition because of the normal coronal drainage.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

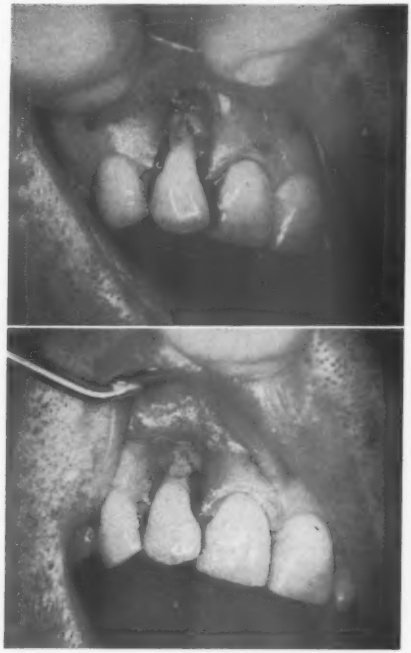

Fig. 5.

Fig. 6.

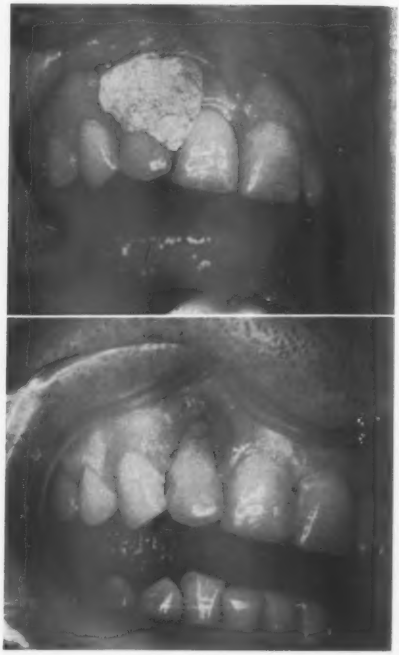

Fig. 7.

Fig. 8.

The amalgam restoration was also polished at this time.) After a negative culture was obtained, the canal was obturated routinely (Fig. 8).

Results.—The soft tissues at this time, approximately two and one-half weeks after institution of endodontic therapy, were completely normal (Fig. 9).

Fig. 9.

DISCUSSION AND CONCLUSION

In this era of high-speed, low-torque techniques, careful guidance of the rotating instruments must still be emphasized. In this particular case, the time taken to penetrate the distance from the lingual tooth surface through the labial tissue was a matter of a few seconds at the most. Even though the perforation occurred, sterile root canal procedures were possible after the secondary channel was sealed off.

1487½ Harper St.

RESEARCH

HOMOPLASTIC TOOTH TRANSPLANTATION IN THE SYRIAN HAMSTER

C. Herman Reece, D.D.S., Oklahoma City, Okla.*

THE transplantation of living tissue is not a new concept. According to God's revelation to Moses,[1] the first recorded operation was the transplantation of tissue. However, we continue to seek for new and better techniques in the study and application of this surgical procedure.

According to Guerini,[2] the historian, Ambroise Paré, father of modern surgery, should be credited with first performing and describing tooth transplantation in 1525.

Charles Allen,[3] who in 1685, wrote the first book in the English language devoted entirely to dentistry, described homotransplantation of teeth. He did not like the idea, however; he said, ". . . it is only robbing Peter to pay Paul."

According to Garretson,[4] John Hunter deserves much credit for popularizing transplantation. It was Younger, however, in 1885, who best demonstrated the desirability of transplantation and the use of a "tooth bank." He transferred a premolar which had been in a cock's comb twelve days to a man's mouth where it fastened itself securely.

In 1915, G. V. Black[2] reported that no histologic studies of specimens involving soft tissue, bone, and transplanted teeth had been made up to that time.

Since 1915 several workers[5-8] have presented histologic reports which would indicate that embryonic dental tissue does possess the power of self-differentiation and persisting after transplantation. However, this does not necessarily apply to the erupted tooth and its supporting structures.

Histologic evidence of viable pulp with odontoblast and excellent periodontal membrane reattachment in replanted hamster teeth has been reported by Myers, Nassimbene, Alley, and Gehrig.[9]

An abridgement of work completed in partial fulfillment of the requirements for a master's degree at the University of Kansas City in 1954. This paper was presented at the Annual Oklahoma House Staff Association meeting in May, 1958.

*Former Oral Surgery Resident, University of Kansas City and at Kansas City General Hospital; presently in private practice and Chief Oral Surgery Resident, University Hospitals, Oklahoma City, Oklahoma.

Recent attempts have been made by Martin[10] and Marlette[11] to transplant hamster teeth for histologic study. Their reports indicate that the proper technique for this study has not yet been demonstrated. With this thought in mind, I decided to seek a technique for the study of homotransplantation of erupted vital teeth.

MATERIALS AND METHODS

Thirty-four Syrian hamsters, aged 4 to 8 weeks, were divided into four groups in an effort to determine the best age and technique for homotransplantation of erupted vital teeth.

The value of the Syrian hamster in dental research was first suggested by Arnold[12] in 1942. The hamster has been used in dental caries studies,[12] production of jaw tumors,[13] postextraction healing,[14] and tooth transplantation experiments.[9-11] Orland[15] has supplied a great deal of information concerning the hamster and his teeth.

Anesthesia was induced by injecting 83 mg. of Nembutal per kilogram of body weight intraperitoneally by means of a tuberculin syringe with a 28 gauge needle. Immediately after injection there was a mild excitement, followed by progressive sedation. Anesthesia was obtained within five minutes and lasted for approximately thirty minutes. No respiratory difficulties were encountered. After the animals were anesthetized, they were placed on a combination animal board, mouth prop, and tongue retractor. Exolevers fashioned from broken dental explorers were used to elevate the tooth from the socket. The tooth was then removed with small thumb forceps, and a water syringe was used to aspirate the excess blood and saliva.

After reviewing the work of Martin[10] and Marlette,[11] it was thought that more successful transplants might be accomplished by removing the mandibular second molar and interradicular bone two weeks before inserting the corresponding tooth from another animal into the healthy granulation tissue. At the time of the second operation, the tooth would not fit into position, so it was decided to use one-stage transplantation of third molars in our study.

The animals were anesthetized, two at a time. The mandibular third molars of one animal were removed bilaterally and placed in Ringer's solution until the same operation could be performed on the other animal. The homotransplant was then placed in the corresponding socket of the host.

Following transplantation, the animals in Groups I and II were returned to their cages and allowed to eat as they desired. The animals in Groups III and IV received no food for twenty-four hours following transplantation. The animals in Group IV also received approximately 7,500 units of penicillin following surgery.

Thirty days after transplantation the surviving animals were sacrificed, and the mandible was removed and sectioned anterior to the first molar and posterior to the third molar. The teeth were then covered with soft tissue for protection during decalcification. The segments were fixed in 4 per cent formalin for seven days and 10 per cent formalin for ten days. The specimen

was then electrically decalcified for approximately sixteen hours, washed in running water for twelve hours, dehydrated in alcohol, and cleansed in chloroform. It was infiltrated with paraffin at 56° C. for four days and then embedded in paraffin blocks. Staggered serial sections at 10 microns were made by mounting every tenth section. The sections were then stained with hematoxylin and eosin.

RESULTS

The results of the homotransplantation of erupted third molars may be seen in Table I.

TABLE I. RESULTS OF HOMOTRANSPLANTATION OF ERUPTED VITAL TEETH IN THE SYRIAN HAMSTER

GROUP	AGE IN WEEKS	NO. OF ANIMALS OPERATED ON	ANESTHETIC DEATHS	NO. OF ANIMALS SURVIVING AFTER 30 DAYS	NO. OF TRANSPLANTS IN THIRTY-DAY SURVIVALS	PERIODONTAL MEMBRANE REATTACHMENT	VITAL PULP
IA	6	6	0				
IB	8	6	0	0	0	No	No
II	8	6	0	1	2	Yes	Yes
III	6	12	0	10	1	Yes	No
IV	4	10	0	1	1	Yes	No

As mentioned earlier, it was not possible to delay transplantation of second molars as was attempted in the animals of Group I.

One animal in the 8-week-old group retained both transplants. Histologic studies revealed areas of normal periodontal membrane attachment. The pulp tissue appeared relatively normal, but the ring of odontoblast was not well visualized. As may be seen in Figs. 1 and 2, the most prominent feature was the excess deposition of predentine.

Ten of the animals in the 6-week age group survived thirty days; however, only one transplant was present at that time. Even though it was involved in pulpal necrosis, a small area of periodontal membrane reattachment may be seen in Fig. 3.

Of the ten animals in the 4-week-old age group that received penicillin, nine died within ten days with the transplant still in position. The left transplant was present in the surviving animal. The photomicrograph in Fig. 4 shows decreased cellularity of the pulp, predentine formation, and an area of normal periodontal membrane reattachment.

DISCUSSION

As one seeks a better technique for performing any procedure, he must first become well acquainted with the techniques already at his disposal. With this in mind, we thought it wise to work on several animals before starting this new adventure. During this preparatory work, it was decided

Fig. 1.

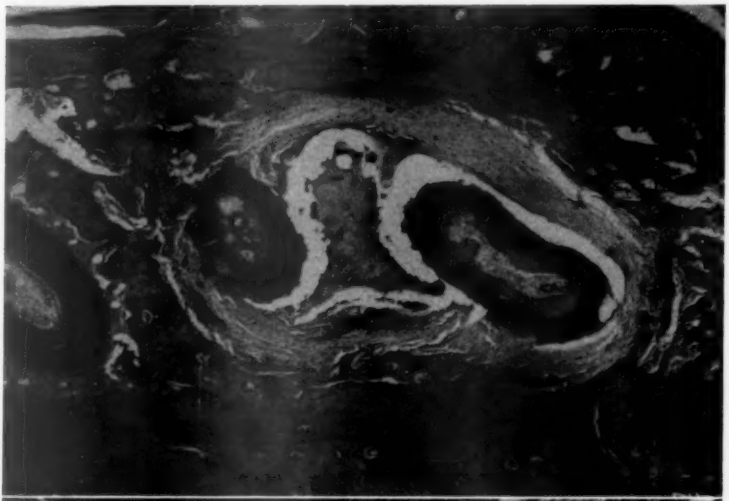

Fig. 2.

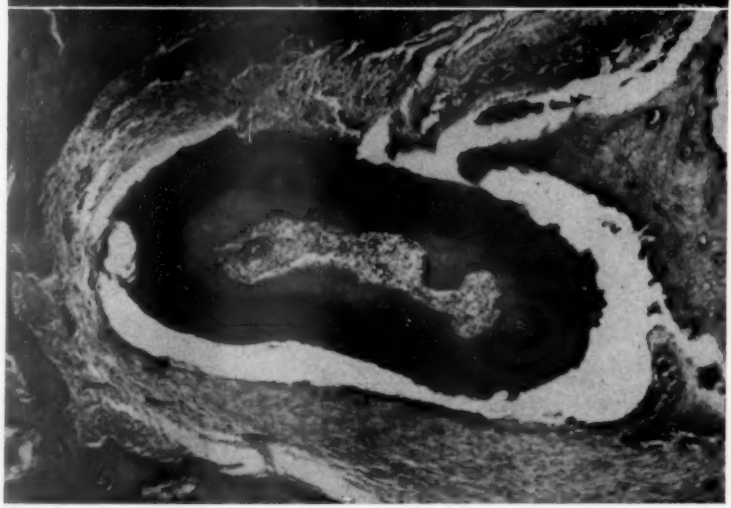

Fig. 1.—Homotransplanted mandibular left third molar after thirty days. Regions of normal periodontal membrane attachment may be seen on both roots. Predentine, viable pulp, and areas of root resorption may also be noted. (R-1, L-5 Sec. 3.)

Fig. 2.—Higher magnification of the larger root seen in Fig. 1. The regions of root resorption and periodontal membrane reattachment are again visible. However, the extensive deposition of predentine and the viable pulp are the prominent points in this area. (R-1, L-5 Sec. 3.)

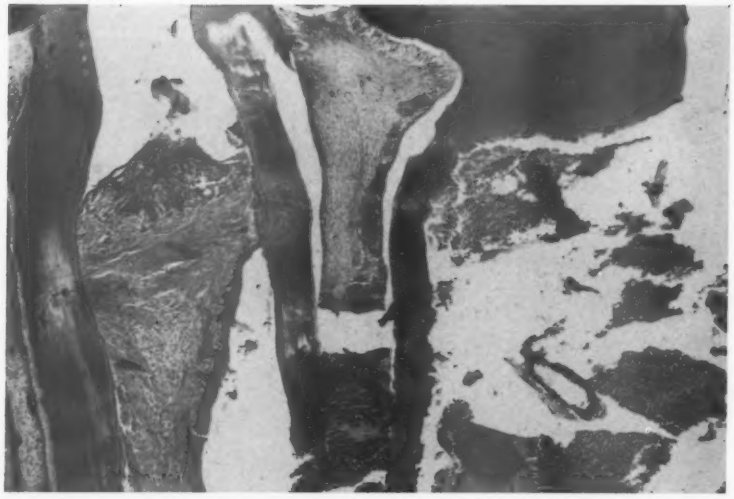

Fig. 3.—Inflammation and necrosis of the pulp and a small area of periodontal membrane reattachment may be seen. The normal layer of odontoblast may be noted in the second molar root. (H-6a, R-8 Sec. 1.)

Fig. 4.—The coronal pulp appears to have a decrease in cellularity and no odontoblastic layer indicating possible necrosis. The periodontal membrane attachment is seen to be normal in this area. (R-3, L-5 Sec. 2.)

that respiratory difficulty might be decreased by using a nongaseous anesthetic. The anesthetic procedure as described in this article has its disadvantages; however, not one anesthetic death occurred in the thirty-four animals anesthetized with Nembutal.

The extraction procedure is one that requires experience. The prevention of excessive hemorrhage and the laceration of tissues are more difficult at first than the actual extraction.

After the Group III transplants, it was decided that the animals should be 4 weeks of age. It was felt that most of the roots would have the same shape at this age and that transplantation would be easier. It was also decided that procaine penicillin should be used in the Group IV animals, since most of the animals in Groups I and II had died following infection of the mandible. More study needs to be done along these lines, as the transplanted third molars all fit very securely in a 4-week-old hamster. However, nine of these ten animals died within ten days with the transplant in position. Did the penicillin kill them? An attempt to answer this question without further experimentation would be foolish indeed.

A satisfactory explanation for the very thick layer of predentine seen in Figs. 1 and 2 may not be given at this time.

Areas of root resorption as noted in Fig. 2 have also been reported in replantation studies.[9, 16]

The areas of periodontal membrane reattachment and the areas of viable pulpal tissue indicate nothing very conclusive. Further study with longer follow-up will be needed.

The following conclusions may be drawn from this study:

1. Homotransplantation of hamster mandibular third molars may be performed with success.
2. Thirty days following transplantation, areas of normal periodontal membrane may be present.
3. Some viable pulp may also be present thirty days posttransplantation.
4. Anesthesia with Nembutal alone resulted in no anesthetic deaths.
5. Tight-fitting homotransplants may be obtained when 4-week-old hamster third molars are used.

Since the completion of this study, more encouraging reports[17] are developing.

We must continue to seek a better understanding of the homotransplantation of living tissue. We already have blood, bone, artery, and eye banks. Possibly, after further study, we may be able to add the tooth bank.

I wish to express my appreciation to Dr. Hugh Myers of the University of Kansas City for his assistance with this project.

REFERENCES

1. Moses: Genesis 1:27-31; 2:21-22.
2. Black, G. V.: Special Dental Pathology, Chicago, 1915, Medico-Dental Publishing Company, p. 47, Fig. 117.

3. Lufkin, A. W.: History of Dentistry, Philadelphia, 1938, Lea & Febiger, p. 78, 99-101, 122.
4. Garretson, J. E.: A System of Oral Surgery, Philadelphia, 1895, J. B. Lippincott Company, p. 233.
5. Editorial: Lancet **2**: 78, 1941.
6. Fleming, H. S.: Homologous and Heterologous Intraocular Growth of Transplanted Tooth Germs, J. D. Res. **31**: 166-189, 1952.
7. Hahn, E. E.: The Capacity of Developing Tooth Germ Elements for Self-Differentiation When Transplanted, J. D. Res. **20**: 5-19, 1941.
8. Kostecka, F.: Transplantation of Tooth Germs, D. Record **58**: 210, 1938.
9. Myers, Hugh, Nassimbene, Leo, Alley, James, and Gehrig, John: Replantation of Teeth in the Hamster, ORAL SURG., ORAL MED. & ORAL PATH. **7**: 1116-1129, 1954.
10. Martin, D. W.: Experimental Tooth Autotransplantation in the Syrian Hamster, Master's Thesis, University of Kansas City, 1954.
11. Marlette, Robert H.: A Review of the Literature on Tooth Plantation Procedures in Dentistry With an Analysis of Recorded Cases and Supplementary Laboratory and Clinical Studies, Master's Thesis, University of Kansas City, 1955.
12. Arnold, F. A.: The Production of Carious Lesions in the Molar Teeth of Hamsters, Public Health Rep. **57**: 1599, 1942.
13. Levy, B. M., and Ring, J. R.: Experimental Production of Jaw Tumors in Hamsters, ORAL SURG., ORAL MED. & ORAL PATH. **3**: 262-271, 1950.
14. Hirschi, Robert Graham: Postextraction Healing in Vitamin A Deficient Hamsters, J. Oral Surg. **8**: 3-11, 1950.
15. Orland, Frank J.: A Study of the Syrian Hamster, Its Molars and Their Lesions, J. D. Res. **25**: 445-455, 1946.
16. Bodecker, C. F., and Lefkowitz, William: Replantation of Teeth, D. Items Interest **57**: 675, 1935.
17. Myers, Hugh: Personal Communication.

514-17 MEDICAL ARTS BLDG.

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ARMED FORCES AND PUBLIC HEALTH SERVICE

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CURRENT TRENDS IN ANTIBIOTICS IN ORAL SURGERY

Charles C. Alling, Lieutenant Colonel, DC, USA, and*
*Edwin J. Pulaski, Colonel, MC, USA***

SURGERY of the structures comprising the oral cavity and contiguous areas is governed and guided by the same principles that govern surgery performed elsewhere in the body. Regardless of whether a minor exodontic operation or a series of major maxillofacial procedures is contemplated, reliance is placed upon an accurate diagnosis established by history and examinations and attended by proper supportive care. The role of antibiotics in oral surgery is predicated upon the need for either general or local supportive care, and the antibiotics of choice are utilized in prophylactic, preventive roles or in the active treatment of infections.

To review the role that antibiotics should have in the practice of oral surgery, this article will cover (1) the characteristics of a widespread organism of the microscopic world that is successfully warding off our counter attacks with antibiotics; (2) the modern antibiotics, with emphasis on their limitations; and (3) the use of antibiotics in oral surgery.

Not only is the array of antibiotics so great as to be confusing unless given constant study, but the terminology found in discussions of these agents is somewhat contradictory. For example, the terms "antibacterial," "anti-infective," "antimocrobial," "chemotherapeutic," and "antibiotic" are used more or less synonymously. Definitive usage of these terms would have "antibacterial" referring to any agent that destroys bacteria, which could include radiation, chemicals, some of the antibiotics, and heat. "Anti-infective" agents would be those specific against a particular infection, such as tetanus antitoxin and quinine. "Antimicrobial agents" is a phrase widely used in some circles,

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but its use could be restricted to the connotation of combating vegetative organisms. "Chemotherapeutic" could include all agents, since inorganic and organic chemistry is all-embracing, but its popular usage pertains to the sulfonamides. The term "antibiotics" refers to the refined laboratory progeny of microorganisms that usually are originally discovered and isolated from soil.

THE STAPHYLOCOCCI

Often the clinician finds that the modern surgical techniques and therapeutic agents master most situations, with the result that school disciplines of microbiology are submerged in a sea of practicality and empiricism. At this very moment, however, the clothing and bodies, the respiratory and digestive tracts of all except the surgically prepared in the population are literally covered with a vicious family of human parasites that go under the informal name of staphylococcus.

The staphylococcus family can survive under a great variety of conditions. In most colonies, mutants are found that differ from the majority in their sensitivity to antibiotics, in pathogenicity, and in growth requirements. This family's characteristic of adaptability may be demonstrated by a consideration of only two of the several enzymes which they can produce: penicillinase and coagulase. Staphylococci are lysed and destroyed by penicillin, with the exception that many strains produce penicillinase which destroys penicillin; of course, such a strain can flourish even though the host, our patient, may be receiving massive doses of penicillin. The adaptability of this microbe is further shown by its extracellular product of coagulase, an enzyme that causes a protective wall of fibrin to deposit on the surface of the staphylococci; this fibrin wall will interfere with the ingestion and destruction of staphylococci by phagocytes. There are produced other enzymes that allow a spreading of the bacteria through the tissues of the patient. This capability for spreading the resistance of the bacteria to antibiotics, the protective shield against phagocytosis, and the overwhelming numbers of this microorganism on our bodies and in our environment make the usually innocuous staphylococci a most potent enemy to the health of our patients.[1]

There are three classical forms of staphylococcal disease: (1) localizing or locally invasive, (2) metastatic, and (3) enterocolitic. The typical lesion is a localized abscess for which coagulase helps to form a limiting wall of coagulated fibrin. This tends to limit the infection, but this wall also interferes with the distribution of systemically administered antibiotics to the colonies of staphylococcus. The typical abscess will have the classical inflammatory response of the surrounding tissues, accumulation of the products of liquefaction toward the area of least anatomic resistance, either spontaneous or surgical incision and drainage, and eventual repair by granulation tissue. Instead of a localized abscess, however, metastatic spread via lymphatic or vascular channels may occur. When we remember the ability of a strain of staphylococci to change characteristics, the ability of this family to protect itself with

enzymes and toxins, the possibility of superimposed infection of other microorganisms or other strains of staphylococci, and the possibility of emergence of antibiotic-resistant strains, then we can better appreciate the need for careful security against an attack by this versatile enemy of our patients.

In treatment centers, a large portion of the staphylococci are antibiotic-resistant, and they are transmitted to the patients from the personnel and environment of the clinic or hospital. Basic in the control of staphylococcal infections are aseptic and sterile techniques, and our patients deserve the protection afforded by surgical soap scrubs of our hands and thorough preparation of the site of injection or operation.[2] Dental units, cabinets, and equipment that are not sterilized between patients should not be handled by the person treating a series of patients. Cloth face masks are not completely effective in containing the staphylococci of our respiratory tracts, and the use of a modern mask containing an air barrier shield is recommended. The practice of removing the mask from the face and letting it hang over one's chest upon leaving the operating or treatment room, then raising the same mask when re-entering the room or entering upon another case is not sound; the oral and nasal secretions have an opportunity to become dried and will drop off or become airborne in concentrated quantities.

There are innumerable strains of staphylococcus producing infections that are resistant to antibiotics and hospitals are the reservoir of most of the resistant strains. This concentration of antibiotic-resistant strains in centers where open wounds are treated and even created during surgery has been a matter of concern to the Joint Commission of Accreditation of Hospitals,[3] the American Hospital Association,[4] the American Medical Association,[5] and the American Dental Association,[6, 7] with the result that the former two agencies have recommended that committees on infections be established. In our considerations on the use of antibiotics in oral surgery, it is significant to note that these recommendations emphasize that vigorous efforts should be made to reduce the indiscriminate prophylactic use of antibiotics and that the principles of aseptic techniques should be enforced.

ANTIBIOTICS

This article has emphasized only the staphylococcus family, one of the many different groups of microorganisms that cause or arise from oral infections. To combat these organisms, the healing arts have available a generously diverse supply of antibiotics. Today there is only a foothill of knowledge about antibiosis, and the future holds the promise of unbounded frontiers for the use of these drugs and the development of even better agents.

In 1940, Chain and associates,[8] following the 1929 observations of Fleming,[9] opened the doors to the clinical use of penicillin as one of the world's most effective and beneficial medicines. In the succeeding years we have seen the products of research laboratories and have witnessed the mass production by the pharmaceutical industry of many allied substances of microbial origin

under the general title of antibiotics. The literature attenting this production of antibiotics has been voluminous and includes articles in all the journals and textbooks of the specialties of the healing arts and sciences.

The contributions of Jawetz and Gunnison included a charting of antibiotics in two groups with a key that helped to classify the theoretical actions of antibiotics with one another (Table I).[10] The synergistic or additive effects are important when we are faced with resistant organisms, emerging resistant

TABLE I.[10] COMBINED ANTIBIOTIC ACTION

GROUP I	Penicillin	GROUP II	Tetracycline
	Streptomycin		Chlortetracycline
	Bacitracin		Oxytetracycline
	Neomycin		Chloramphenicol
	Polymyxin		Erythromycin
I + I	Often synergistic or indifferent, never antagonistic		
II + II	Often additive or indifferent, never synergistic		
I + II	Indifferent, antagonistic, or synergistic, depending in part on behavior of microorgansims toward Group I drug; if very I-sensitive, occasional antagonism; if relatively I-resistant, occasional synergism		
Sulfonamides fit into Group II			

(From Jawetz and Gunnison: *Antibiotics & Chemother.* 2: 243-248, 1952.)

mutant strains, or mixed infections. In any given situation, these combinations are intended as guides that should be substantiated, ideally, by laboratory evaluations since the degree of synergism or antagonism is dependent upon the relative concentrations of the drugs when they reach the offending organisms, the individual mechanisms which the antibiotics use to exert their effect, and the variations in the effects observed against different species of organisms and possibly against different strains of the same species.[11] In Table I, Group I antibiotics are best against rapidly multiplying bacteria and are principally bactericidal in action when administered in the proper concentrations; the action of Group II antibiotics is principally bacteriostatic.

Penicillin, in its thirty to forty different commercial preparations, is still the most common and most widely used antibiotic and is particularly indicated against hemolytic streptococcal and pneumococcal infections. Its advantages in oral surgery are enhanced because it is bactericidal against certain gram-positive organisms that usually are found in dentoalveolar abscesses and because its narrow spectrum of effectiveness will not upset the normal flora of the body and predispose to superinfection by staphylococcus.[12] Procaine penicillin G (Depo-penicillin, Diurnal penicillin, procaine penicillin G) diluted in sesame or peanut oil may be purchased already mixed, and intramuscular injections provide early high blood serum levels with therapeutic concentrations persisting in the blood stream for at least twenty-four hours. Benzathine penicillin G (Bicillin, Permapen) administered intramuscularly in large doses will provide protection against organisms, such as those of syphilis, that are highly sensitive to penicillin by establishing an effective serum level for one to four weeks following a single injection. Potassium penicillin G (Dramcillin, Dropcillin, Penalev, potassium penicillin G, Readicillin) may be administered topically,

intramuscularly, or, when an immediate high blood serum level is necessary, intravenously in an aqueous solution. Penicillin V (Pen-Vee, V-Cillin) and its related agents (Compocillin-V hydrabamine, Compocillin-V potassium) are administered orally and pass through the stomach with minimum inactivation. Therefore, they are available for absorption from the duodenum producing serum levels almost equivalent to parenterally administered penicillin. Penicillin for parenteral, oral, and topical use is available in combination with several other antibiotics, including streptomycin, dihydrostreptomycin, bacitracin, and the sulfonamides.

Penicillin[13] not only carries its continuing promises of benefit to mankind but it is also a real threat to the lives of an increasing number of the patients who receive it. Welch's[14] survey of one-third of all the general hospitals in this country for a three-year period ending in 1957 indicated that about 1,000 cases of life-threatening complications were seen following the use of antibiotics, and penicillin or penicillin in combination with other antibiotics was responsible for about 90 per cent of these reactions. Of the life-threatening complications with an over-all mortality rate of 10 per cent, anaphylactoid reactions following administration of penicillin preparations constituted the most common major complication. The remaining major reactions noted with penicillin were severe skin disorders with deaths recorded from exfoliative dermatitis and erythema multiforme, blood dyscrasias, and angioneurotic edema with respiratory-cerebral involvement. Intramuscularly administered penicillin accounted for the most severe and greatest number of complications recorded in this survey. Anaphylactoid shock was noted in a few cases following oral and topical use of penicillin preparations, however, such as two cases in which adults merely tasted penicillin suspensions intended for children, one case in which a woman used a penicillin oral troche, and two cases in which an endodontic paste containing penicillin was used in root canal therapy.

Penicillin, according to Welch's survey,[14] accounted for 90 per cent of the cases of reactions to antibiotics that were classified as not life-threatening but evidently severe enough to warrant hospital attention. These reactions included urticaria and angioneurotic edema, dermal lesions, serum sickness, diarrhea, and local moniliasis. These minor reactions carry the possibility of being the precursors to major catastrophe if the patient has future exposures to the same antibiotic.

Various methods of combating the antigenic threat of the 325 tons of penicillin produced annually in the United States[15] have included the taking of a careful history to ascertain previous reactions to this antibiotic or other allergic tendencies, placing a tourniquet proximal to the injection site so that it may be tightened in the event of a reaction, skin and conjunctival-sac testing,[16] the use of such symptom-suppressing drugs as the steroids and antihistamines, the use of orally administered tablets to allow for a slower absorption than that of intramuscular injections, and the administration of penicillinase following reactions. The most effective methods of protecting our patients from being among the 200 to 300 who, it is predicted, will die this year from penicillin

reactions[17] are first and foremost, to take a careful history; second, if an anaphylactoid reaction occurs, administer 0.2 to 0.3 ml. of 1:1,000 epinephrine subcutaneously only and institute antishock therapy; and in the event of a delayed reaction, administer penicillinase.[18]

With 5 per cent of the population allergic to penicillin,[19] it is likely that any dental or medical practice using quantities of penicillin will eventually produce an allergic reaction. Penicillinase, a bacterial enzyme administered in 800,000 units, will destroy penicillin, thereby correcting the antigenic allergen rather than only suppressing the symptoms. Suppression of the symptoms of the reaction with steroids or antihistamines may be desirable during the period before the penicillinase completely destroys the penicillin.[18]

The administration of penicillin should begin one day prior to surgery; 300,000 to 600,000 units of procaine penicillin should be given intramuscularly twice daily, or 250 to 500 mg. (400,000 to 800,000 units) of penicillin V orally should be given three to four times daily. The same doses should be continued every day for four days or longer if necessary. If a rapid, immediately high blood level is desired, potassium penicillin G can be given intramuscularly to produce therapeutic blood levels in fifteen minutes. Streptomycin or dihydrostreptomycin, 0.5 to 1 Gm. intramuscularly, may be added to the above dosages, particularly when one is dealing with suspected mixed infections.

Streptomycin, in adequate dosages, is essentially a bactericidal agent against both gram-positive and gram-negative organisms. In lesser dosages it may be only bacteriostatic, and in low concentrations it may actually stimulate growth of microorganisms.[20] The major problems encountered with streptomycin have been the emergence of resistant strains of microorganisms during streptomycin therapy and the possibility of irreversible damage to the vestibular portion of the eighth cranial nerve due to the specific toxicity of streptomycin. *Dihydrostreptomycin* is a product of hydrogenation of streptomycin and has similiar clinical properties, but the toxic effect of dihydrostreptomycin is primarily to the auditory portion of the eighth nerve causing deafness. Since the combined action of the streptomycin and dihydrostreptomycin is additive, and since the toxic effects to the eighth nerve are negligible if the dose is below 1 Gm. daily[1] and adminstration is limited to a period not exceeding one week,[21] mixtures of the two agents may be used—0.5 Gm. streptomycin and 0.5 Gm. dihydrostreptomycin or alternation of the two antibiotics on alternating days, thereby decreasing the cumulative effects. In oral surgery one week's administration usually will suffice to control the infection, and at the end of this period we begin to face the possibility of emerging strains of resistant microorganisms which would contraindicate longer therapy with this antibiotic.

Erythromycin (Erythrocin, Ilotycin) is similar to penicillin in its spectrum of effectiveness against staphylococcal as well as streptococcal infections, but this effectiveness is at the bacteriostatic rather than the bactericidal level.

In cases of penicillin allergy erythromycin has been used as an alternate drug, but its use should be limited to one week because of the potential emergence of erythromycin-resistant mutant strains of staphylococci; other antibiotics given concurrently (for example, streptomycin or dihydrostreptomycin) may decrease the speed of development of these mutants. Erythromycin is a presently useful agent against penicillin- and tetracycline-resistant staphylococci and has very few undesirable side effects. In a ranking of antibiotics according to effectiveness against staphylococcus collected in a hospital, penicillin ranks low and erythromycin is among the most effective.[12]

The tetracycline antibiotics—*chlortetracycline* (Aureomycin), *oxytetracycline* (Terramycin), and *tetracycline* (Achromycin, Panmycin, Polycycline, Steclin, Tetracyn)—are bacteriostatic agents with similar antibacterial properties against susceptible gram-positive and gram-negative organisms and are popular and useful additions to pharmacologic prescriptions of medical and dental outpatient practices. If a minor complication, such as gastrointestinal reactions, nausea, or vomiting, should occur, with the use of one of these agents, then another of the group may be employed. The genuine danger from these agents lies in their broad-spectrum properties and their ability to suppress the normal bacterial flora of the gastrointestinal tract and allow other microorganisms to flourish. Letterman Army Hospital has recently observed two of these superinfections. In one case the use of one of these agents resulted in a moniliasis of the oral cavity, gastrointestinal tract, and respiratory tree which caused a protracted, disabling illness and eventually the loss of one lung. The other case terminated in the death of a 30-year-old woman one week after she received oxytetracycline as a prophylactic measure prior to extraction of abscessed teeth; a staphylococcus infection, resistant to the oxytetracycline, apparently took origin from the abscessed teeth and spread over the mouth and down the gastrointestinal tract which had been previously sterilized of its normal protective flora by the oxytetracycline; toxic products of the staphylococcus led to sloughing of most of the epithelium throughout the gastrointestinal tract. The immediate cause of death was probably cardiac arrhythmia secondary to staphylococcal toxemia. These cases serve to emphasize that antibiotics are potent agents, and the risk to our patients must be assessed against the potential benefit that we expect to derive when we expose our patients to antibiotic or, for that matter, any other therapy.

Chloramphenicol (Chloromycetin) has a spectrum of bacteriostatic coverage of microorganisms similar to that of the tetracyclines, except that staphylococci resistant to the tetracyclines are usually sensitive to chloramphenicol. Chloramphenicol has the advantage of being distributed in the cerebrospinal fluid which is an asset in the treatment of maxillofacial injuries with fractures compounding into the cranial vault. Chloramphenicol has the well-publicized potential of depressing the normal activity of the hematopoietic tissues which may lead to an aplastic anemia. This factor has limited its use in oral surgery through the years to combating microorganisms that have been proved by bacteriologic examination to be sensitive to chloramphenicol. In the usual

five- to seven-day course of antibiosis used in oral surgery, however, and with controlling surveillance by a hematologic laboratory, we have no hesitation in prescribing chloramphenicol.

Oral forms of the tetracyclines, erythromycin, and chloramphenicol may be administered with a loading dose of 500 mg. to 1 Gm. and followed by 2.0 to 3.0 Gm. per day, divided into four equal doses. These antibiotics may be given intravenously if the patient's condition precludes oral administration, which is a distinct advantage in maxillofacial surgery; after the first day or so, if the patient is still unable to take the drug orally, it can be administered via a Levin tube, since tube feeding probably will have been started by that time. Intramuscular preparations of certain of these antibiotics are available, but patients do complain of pain at the injection site. Oxytetracycline and tetracycline in combination with triacetyloleandomycin are marketed with an excipient, glucosamine, which speeds the absorption of the antibiotic from the gastrointestinal tract (Cosa-Signemycin, Cosa-Terramycin).

Bacitracin, neomycin, and *polymyxin B sulfate* are all bactericidal against gram-negative organisms and find a use in oral medicine in their topical applications for infections of the mucous membranes. These three agents are of different chemical origins, but they share the side effects of possible kidney damage and other complications that make their systemic use limited in dentistry. Lozenges in various combinations with these antibiotics, with other antibiotics, and with topical anesthetics are available. Bender and Pressman[22] conducted extensive studies confirming the theory that postextraction bacteremia consists of bacteria from the oral cavity that gained access to the blood stream through the dental extraction procedures and that antibiotic troches significantly reduced the incidence of postextraction bacteremia.

Nystatin (Mycostatin) is used to treat or prevent monilial infections. For the patient afflicted with moniliasis (thrush) of the oral mucosa, nystatin may be applied as a direct, topical, specific medication. In the event the monilial organism, *Candida albicans,* has caused a superinfection during the use of a broad-spectrum antibiotic, then a concomitant administration of nystatin and the antibiotic may be instituted.[13] However, for the usual relatively short course of broad-spectrum antibiotic therapy as practiced in dentistry, the routine concurrent administration of nystatin and the broad-spectrum antibiotic is indicated.

From the soils of all corners of the earth, the research departments of universities and the international pharmaceutical industry have identified microbes that provide new antibiotics such as *kanamycin, novobiocin, oleandomycin, triacetyloleandomycin, vancomycin,* and *ristocetin.* These antibiotics have given dramatic relief in epidemics of staphylococcal infections where older antibiotics met only resistant strains. In most practices, their present use should be reserved for therapy of infections bacteriologically proved to be resistant to other drugs.

The sulfonamides are chemotherapeutic agents that are bacteriostatic for both gram-negative and gram-positive organisms. Many compounds of sulfonamides have been developed since the sulfonamide-pioneering days of the

1930's, and they have extended the usefulness of this large group of compounds. The modern sulfonamides have the advantages of sustained blood levels with small doses, low allergenic potentials, and relative freedom from risk of renal blockage. Among the sulfonamides that are important members of our pharmacologic armamentarium and that are used in oral surgery to supplement the indicated antibiotic are *sulfisoxazole* (Gantrisin) and the pyrimidine derivatives, *sulfadiazine, sulfamerazine,* and *sulfamethazine,* which are used singly or in combination with antibiotics and with each other (Citrasulfas, Neotrizine, Sulfatriad, Sulfa-Triplex, Sulfonsol, Syrosulfas, Terfonyl, Triple Sulfas, Truozine). Since these agents are distributed to all the body fluids, including the cerebrospinal, there is an indication for administering them in the face of findings of cerebrospinal rhinorrhea associated with maxillofacial injuries.

CLINICAL APPLICATION OF ANTIBIOTICS

Fundamental in the use of antibiotics is the establishment of a factor of infection which is to be corrected or prevented. A careful history will often give the diagnosis, and examination procedures will confirm or positively establish the diagnosis. Both of these techniques—the history and the examination—are time consuming, but the exact designation of the patient's complaint in its proper scientific frame is one of the highest rewards of practice.[23] Various lesions will be manifested by signs and symptoms similar to those of an infection. Delineation of neoplasms, developmental anomalies, cysts, oral manifestations of systemic diseases, blastomatoid disorders, and inflammatory diseases from a lesion caused primarily or secondarily by microorganisms requires a respectful regard for the principles of practice.[24]

Microorganisms of the oral cavities of the population vary both in number and in type. Detritus, the presence of organic matter, calculus, pericoronal flaps over erupting teeth, irregularities of the mucosa (such as the papillary hyperplasia occasionally seen under artificial dentures), inaccurately designed dental restorations for carious or missing teeth, and the presence of infections in the otorhinolaryngological areas will harbor microorganisms and provide a warm, moist, nutritive environment for their proliferation. Nonhemolytic streptococci are the predominating organism of the normal mouth, but the real culprits are the anaerobic streptococci, whose power to destroy tissue is frequently augmented by associated fusiform bacilli and spirochetes. Other important organisms include the staphylococci, the hemolytic streptococci, and the meningococci. These microbes, together with the actinomycotic, syphilitic, tubercular organisms and the more unusual viruses and fungi, may appear in the oral cavity or contiguous tissues. Therefore, the most effective use of antibiotics follows not only the accurate history and examination but also the positive identification of the microorganisms by bacteriologic means. The techniques of the bacteriology laboratory will pinpoint the organisms to be attacked and tell the clinician which antibiotics to utilize.

Acute infections include periapical, parietal, and pericoronal abscesses, ulceromembranous stomatitis, acute osteomyelitis, and infections and cellulitis of the contiguous facial spaces. It is in the acute infections that the indicated surgery together with the judicious use of antibiotics has afforded the most rewarding responses to antibiotic therapy (Fig. 1). While awaiting the bacteriology report, the patient may be started on an antibiotic and the indicated

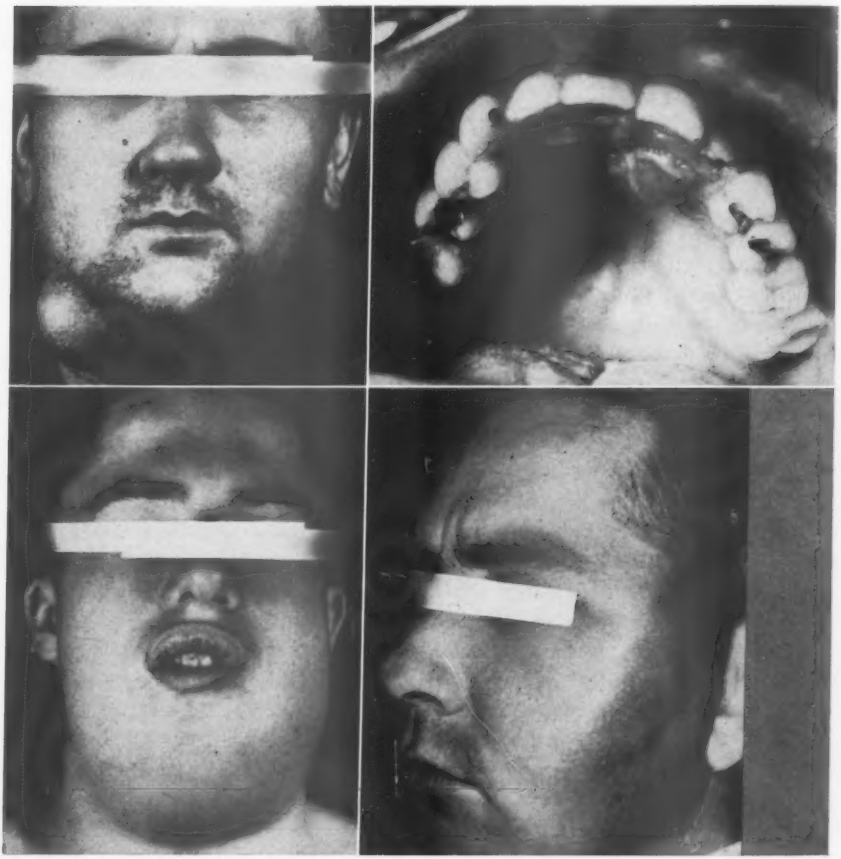

Fig. 1.—*A*, Submaxillary cellulitis arising from a periapical inflammation of a mandibular molar.

B, Palatal mucoperiosteal abscess secondary to periapical necrosis of a retained, nonvital, deciduous cuspid.

C, Ludwig's angina due to periodontal infections with parietal abscesses of the mandibular dentition.

D, Temporal and infratemporal space cellulitis secondary to pericoronal infection and inflammation of an unerupted maxillary third molar.

The surgical treatment for all of these cases consisted of dental extractions and an incision-and-drainage procedure following establishment of systemic antibiosis; recovery was prompt and complete in each case. (A tracheostomy was performed as a preventive measure in the case of the Ludwig's angina.)

(U.S. Army photographs.)

surgery may be performed. The earlier the antibiotic and surgical treatment, the more immediate and permanent will be the response, and the less will be the amount of tissue damage.

Chronic infections are possible when the bacteria have established themselves in an area that is relatively inaccessible to leukocytes or have surrounded themselves in an environment in which they can meet the leukocytes on equal terms. Bacterial strongholds could be the sequestrum in bone necrosis, chronic osteomyelitis, chronic marginal gingivitis, pericoronal flaps, poorly designed dental restorations and prostheses, papillary hyperplasia of the oral mucosa, and periapical granulomas. These situations provide too foul an

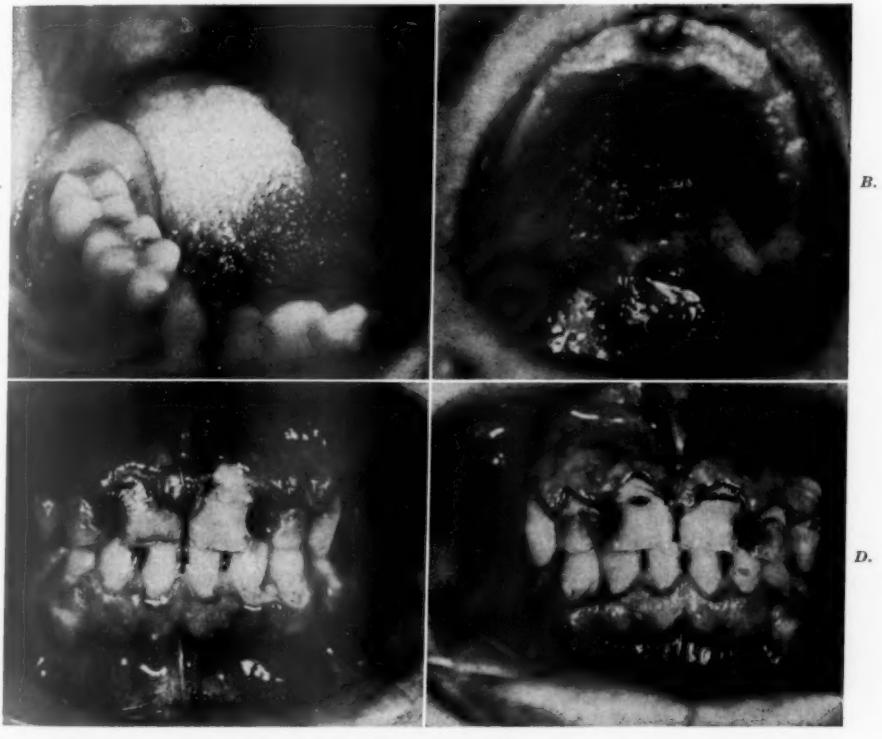

Fig. 2.—*A*, Pericoronal flap over the mandibular third molar was contributing to a recurring gingivitis. Patient had been treated with systemic and local antibiotics, vitamins, and dental prophylaxis. Following removal of the third molars, the gingivitis responded to routine periodontal care.

B, Papillary hyperplasia under an ill-fitting denture. Considerable debris is found in this type of lesion, which will stimulate more inflammatory changes; biopsy will occasionally return a diagnosis of carcinoma from such an area. A biopsy specimen was taken, the lesion was destroyed with electrodissection instruments, and new dentures were constructed.

C and *D*, Marginal gingivitis (*C*) with signs of becoming an ulceromembranous stomatitis responded in twenty-four hours to periodontal removal of debris and calculus. No antibiotics were used. Periodontal removal of debris and calculus disclosed a marked reduction in the inflammation in twenty-four hours (*D*). No antibiotics were used. (Case courtesy of Major W. B. Bell, DC, USA.)

(U.S. Army photographs.)

environment to permit the survival of leukocytes, even if they should enter, but these are ideal areas for the cultivation of pathogenic organisms (Fig. 2). Even if blood serum and tissue fluid containing antibiotics seep into these areas, the prospect of cure is most unlikely because either the environmental factors are detrimental to the action of the antibiotics or there is a low metabolic turnover of the bacteria. Therefore, the indiscriminate use of antibiotics in the treatment of infections of this kind can lead only to disappointment. The place of antibiotics in these instances is in the prevention against spread of infection arising during surgical intervention.

The greatest use of antibiotics at present, and predictably in the future, is in discriminate, selective prophylaxis against infections. In the routine extraction of teeth and in the overwhelmingly greatest amount of minor oral surgery, such as root resections, surgery for immediate dentures, biopsies, and excision of small cysts and tumors, there is no need for antibiotic prophylaxis in otherwise healthy mouths. There are conditions, however, in which the use of these drugs has become indispensable and, in fact, has completely revolutionized treatment. Surgical correction of chronic and acute infections is performed with safety while the use of systemic antibiosis protects against a spread of the infection. Extraoral and even intraoral mandibular and maxillary resections and bone grafts are successfully managed with the aid of protection from antibiotics. In maxillofacial injuries the incidence of nonunion is extremely infrequent, and the untoward sequelae of osteomyelitis are becoming rare since the advent of antibiotics. Open reduction of facial-bone fractures was a measure of last resort prior to the modern use of antibiotics; now accurate approximation with direct fixation of the fractured fragments via open operations has been developed by oral surgeons to a high degree of perfection due to the protection against infections possible in this antibiotic era. If a fracture is in the body of the mandible, it usually should be considered as a compound fracture because of the possibility of infection from the oral cavity to the fracture site through the dental alveoli or lacerations in the oral mucosa; even though a closed-reduction technique may be utilized, a systemic course of antibiotics maintained for several days will prevent the sepsis which often supervened before the advent of antibiotics. When a maxillofacial injury is complicated by craniocerebral involvement, it is well to administer a sulfonamide and/or chloramphenicol to protect against meningococcal meningitis (Fig. 3).

There are cases in which a bacterial shower of the blood stream following oral surgery is dangerous. Normally, these bacteria are rapidly killed by the reticuloendothelial cells, but in a patient with fibrinous vegetations on the heart valves there is always a danger of the organisms being implanted on the heart valves, thereby causing an infective endocarditis. Whenever a dental operation, including dental prophylaxis, restorative dentistry, exodontia, and oral surgery, is to be performed on a patient with cardiovascular disease or on a patient who has had rheumatic fever in early life, it is of first importance to take the added precaution of giving antibiotics pre- and postoperatively. The American Heart Association[25] currently recommends that 600,000

units of procaine penicillin and 600,000 units of aqueous penicillin be given intramuscularly thirty minutes before surgery. As an alternative, 250,000 to 500,000 units of penicillin orally before meals and at bedtime may be instituted the day before surgery and continued for five days; at the time of the surgical procedure an additional 250,000 units is advised. For patients allergic to penicillin, the Association recommends tetracycline or erythromycin in full doses for five days, beginning on the day before surgery.

Fig. 3.—*A* and *B*, Fractures of the mandibular symphysis, left subcondylar neck, maxillae, nasal bones, and malar bones, and a craniofacial dysjunction with cerebrospinal rhinorrhea.

C and *D*, Six weeks postoperatively. Systemic treatment included chloromycetin antibiosis. The oral surgical treatment consisted of closed reduction and intermaxillary immobilization of the mandibular fractures, internal craniofacial suspension from the zygomatic processes of the frontal bone using the dental occlusion for the final anatomic alignment, and open reduction with elevation and transosseous wiring of the malar bones via an eyebrow incision line. The cerebrospinal rhinorrhea ceased within twelve hours postoperatively.

(U.S. Army photographs.)

To decrease the oral bacterial flora prior to an oral operation as a preventive measure against bacteremia, the patient may hold a dissolving antibiotic lozenge in the oral cavity for thirty to sixty minutes prior to the operation.[22] This local therapy should be in conjunction with general systemic antibiosis as recommended by the American Heart Association for maximum protection against the bacterial shower of the blood stream following a dental procedure. With the bacterial shower identified specifically with organisms

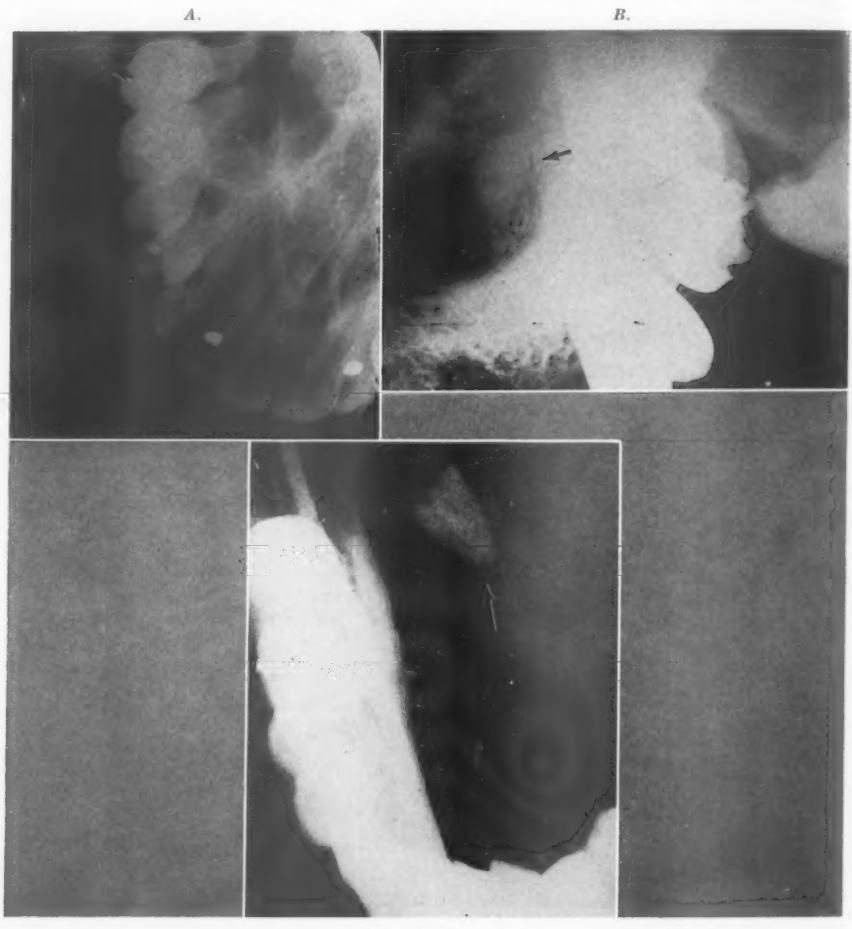

Fig. 4.—*A*, Maxillary third molar displaced during removal to beneath the anterior buttress of the zygomatic arch.

B, Maxillary first molar fragment displaced into the maxillary antrum.

C, Mandibular third molar root fragment displaced into the submaxillary gland through the mandibular lingual plate.

Under cover of systemic antibiosis of either penicillin and streptomycin or erythromycin, each of these odontogenic foreign bodies was removed without further complication to the patient.

(U.S. Army photographs.)

from the oral cavity, and with a greater incidence of major maxillofacial procedures being performed by newer techniques of intraoral surgery, there is a place for preoperative preparation of the oral cavity with local, topical antibiosis.

In certain complications following oral surgery there is an indication for antibiotic prophylaxis. Following perforation of the maxillary sinus many patients have been spared a lifelong sinus disease by the prompt administration of antibiotics; streptomycin is effective against acid-fast bacilli and gram-negative rods, organisms prevalent in the respiratory tract; and the administration of streptomycin and penicillin, sometimes synergistic in their combined usage, is desirable in cases of mixed infections. Displacement of a maxillary third molar through the posterior wall of the maxilla into the infratemporal fossa may initiate a widespread ascending infection to the brain, and displacement of fragments of the mandibular third molar through the lingual cortical plate establishes an open avenue for the spread of infection through the spaces of the neck. The severity of these complications is materially lessened by prompt antibiotic prophylaxis (Fig. 4).

Dental antibiotic chemotherapeutic cones and pastes are marketed for insertion in sockets after extraction of teeth; their sphere of antibiotic influence must be relatively small, even under ideal conditions of pH, sensitive microorganisms, and the mechanical retention of the medicament. There has been documented a wide variation of favorable and less enthusiastic reports following clinical trials, experimental studies, and controlled clinical studies of a wide variety of these cones and pastes.[26, 27] It is of interest to note that a nonantibiotic hemostatic material has been inserted into dental sockets, reportedly decreasing the incidence of the postextraction osteomyelitic syndrome; this leads to speculation that perhaps the primary benefit of medicated cones and pastes is to decrease mechanically the amount of coagulum that has to be organized and vitalized in the first critical stages of repair following dental extractions. It would appear that an investigation of the basic mechanisms of the reported beneficial results following the insertion of these foreign bodies would be meaningful.

If antibiotic therapy is indicated, it should be undertaken vigorously to avoid a therapeutic failure. Possible causes of failures of the antibiotics to correct or prevent an infection include the following:

(1) The use of antibiotics as substitutes for surgery, particularly incision and drainage procedures.

(2) The causative organism not being sensitive to the antibiotic employed.

(3) Presence of emerging strains of bacteria resistant to the antibiotic.

(4) Alteration of the bacterial flora during treatment (superinfection).

(5) Inaccessibility of the lesion so that the therapeutic agent cannot be brought into contact with it. Chronic oral infection, bony sequestra, and infections surrounded by a protective membrane are examples of this difficulty.

(6) Inadequate dosage. In certain situations, low doses may actually stimulate the growth of bacteria; inadequate dosages may merely arrest the growth of the bacteria, whereas the indicated blood level of antibiosis would be bactericidal.

(7) Too early withdrawal of therapy.

(8) Failure to supplement antibiotic therapy with general supportive care.

(9) The lesion having an etiology that is other than bacterial.

CONCLUSIONS

1. Antibiotics are liberally administered to patients by all the disciplines of the healing arts and from proprietary sources. In view of the quantity administered, they are relatively safe drugs.

2. There are severe, life-threatening reactions possible following the use of antibiotics, and the question of the potential benefit to the patient versus the risk that he will face must be constantly weighed.

3. It is evident that antibiotics have not modified sound surgical principles. Due to the emerging resistant strains of bacteria, however, this era of antibiosis calls for a reinforcing of sound surgical practices.

4. Antibiotics have allowed a greater latitude in the surgical procedures that may be performed, and they have greatly reduced morbidity following surgery.

REFERENCES

1. Jawetz, E., Melnick, J. L., and Adelberg, E. A.: Review of Medical Microbiology, ed. 2, Los Altos, Calif., 1956, Lange Medical Publications, pp. 132-135.
2. Hoffman, H.: Hygiene of the Hands in Dental Practice, ORAL SURG., ORAL MED. & ORAL PATH. **11**: 216-221, 1958.
3. Editorial: Bulletin of the Joint Commission on Accreditation of Hospitals, No. 17, 1958.
4. Editorial: American Hospital Association: Prevention and Control of Staphylococcus Infections in Hospitals (Bulletin 1), May 21, 1958.
5. Editorial: Staphylococcic Infections, J. A. M. A. **166**: 1205, 1958.
6. Editorial: Prevention and Control of Staphylococcus Infections in Hospitals, J. Am. Dent. A. **57**: 283-286, 1958.
7. Editorial: Prevention and Control of Staphylococcus Infections in Hospitals, J. Oral Surg. **16**: 430-433, 1958.
8. Chain, E., and Others: Penicillin as a Chemotherapeutic Agent, Lancet **2**: 226-228, 1940.
9. Fleming, A.: On the Antibacterial Action of Cultures of Penicillium, With Special Reference to Their Use in Isolation of Bacillus Influenzae, Brit. J. Exper. Path. **10**: 226-236, 1929.
10. Jawetz, E., and Gunnison, J. B.: Studies on Antibiotic Synergism and Antagonism: A Scheme of Combined Antibiotic Action, Antibiotics & Chemother. **2**: 243-248, 1952.
11. Hobby, Gladys: Syngerism, Antagonism, and Hormesis With Reference to Antimicrobial Substances. In Welch, H.: Principles and Practice of Antibiotic Therapy, New York, 1954, Medical Encyclopedia, Inc., pp. 263-294.

13. Waisbren, B. A., and Strelitzer, C. L.: A Five-Year Study of the Antibiotic Sensitivities and Cross-Resistances of Staphylococci in a General Hospital. In Welch, H., and Marti-Ibañez, F. (editors): Antibiotics Annual, 1957-1958, New York, 1958, Medical Encyclopedia, Inc., pp. 350-364.
14. New and Nonofficial Drugs, Philadelphia, 1958, J. B. Lippincott Company, pp. 94-96.
15. Welch, H., Lewis, C. N., Weinstein, H. I., and Boeckman, B. B.: Severe Reactions to Antibiotics. In Welch, H., and Marti-Ibañez, F. (editors): Antibiotics Annual, 1957-1958, New York, 1958, Medical Encyclopedia, Inc., pp. 296-309.
16. Goodman, L. S., and Gilman, A.: The Pharmacological Basis of Therapeutics, ed. 2, New York, 1955, The Macmillan Company, p. 1326.
17. Smith, V. M.: Fatal Reactions to Penicillin: Evaluation of a Test for Sensitivity, New England J. Med. **257**: 447-451, 1957.
18. Becker, R. M.: Penicillinase Treatment of Penicillin Reactions. In Welch, H., and Marti-Ibañez, F. (editors): Antibiotics Annual, 1957-1958, New York, 1958, Medical Encyclopedia, Inc., pp. 310-311.
19. Zimmerman, M. C.: Penicillinase Treatment of Fifty-Two Patients With Allergic Reactions to Penicillin. In Welch, H., and Marti-Ibañez, F. (editors): Antibiotics Annual, 1957-1958, New York, 1958, Medical Encyclopedia, Inc., pp. 312-320.
20. Kitchen, D. K., Rein, C. R., Thomas, E. W., and Spoor, H. J.: Reactions to Penicillin, Am. J. Syph. Gonor. & Ven. Dis. **35**: 578-582, 1951.
21. Curran, H. R., and Evans, F. R.: Stimulation of Sporogenic and Nonsporogenic Bacteria by Traces of Penicillin or Streptomycin, Proc. Soc. Exper. Biol. & Med. **64**: 231-233, 1947.
22. Northrop, P. M.: Preoperative Management of the Oral Surgery Patient, J. Oral Surg. **11**: 105-117, 1953.
23. Bender, I. B., and Pressman, R. S.: Antibiotic Treatment of the Gingival Sulcus in Prevention of Postextraction Bacteremia, J. Oral Surg. **14**: 20-28, 1956.
24. Dingman, R. O., and Hayward, J. R.: The Value of Writing Case Histories, J. Oral Surg. **5**: 123-129, 1947.
25. Pulaski, E. J.: Surgical Infections, Springfield, Ill., 1954, Charles C Thomas, pp. 101-112.
26. American Heart Association: Prevention of Rheumatic Fever and Bacterial Endocarditis Through Control of Streptococcal Infections, Circulation **11**: 319, 1955 (Sect. 4, A and B).
27. Zander, H. A., and Clark, H. B., Jr.: Antibiotic Therapy in Oral Surgery and Dentistry. In Welch, H.: Principles and Practice of Antibiotic Therapy, New York, 1954, Medical Encyclopedia, Inc., pp. 663-682.
28. Mourfield, W. R., and Barron, J. M.: Clinical Evaluation of Erythromycin Dental Cones in Oral Surgery, ORAL SURG., ORAL MED. & ORAL PATH. **11**: 584-586, 1958.
29. Morris, E. E., and Ping, R. S.: A New Sterile Absorbable Hemostatic Dental Cone, J. Indiana State Dent. A. **37**: 10, 1958.

PERIPHERAL AMELOBLASTOMA

Report of a Case

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AN AMELOBLASTOMA of the jaw in a peripheral position is exceedingly rare. Of more than 1,000 cases of ameloblastoma recorded in the literature, only two suggested a peripheral site. The term "peripheral" is used to indicate an extraosseous position, in the sense of peripheral versus central growth.[1] Such soft tissue lesions would overlie the jawbones and would not include those found in more remote locations, as the buccal mucosa, lip, craniopharyngeal duct, or tibia.

In almost all instances, the ameloblastoma originates centrally within the bone. The tumor cells have the capacity to locally invade and destroy bone but not to metastasize.[2] Bernier[3] preferred to describe its growth as expansive rather than invasive. Robinson[4] felt that the word "persistent" was more accurate than the word "malignant." Even though the tumor becomes large or exists for a long time, the soft tissue does not usually become involved. This is an important diagnostic point, since malignant tumor cells, such as carcinoma, invade and destroy soft tissue.[5]

The central ameloblastoma is found in the mandible more commonly than the maxilla and in the region of the molars and premolars, the ramus, and the symphysis of the mandible. The tumor may be derived from the enamel organ or the dental lamina, cell rests of the enamel organ either during tooth development or later, the epithelium of odontogenic cysts, the mucosal epithelium covering the jaw, or displaced epithelium in other parts of the body.[5]

Many investigators[6-9] have favored the basal-cell layer of the surface epithelium as the origin of these growths. Fish[10] and McWhirter and associates[11] claimed the surface epithelium to be the chief site of origin. Small and Waldron[2] pointed out, as did Siegmund and Weber,[12] that such an origin was difficult to prove. Small and Waldron observed many sections in which the tumor elements appeared to fuse with the overlying oral epithelium, but they believed that the characteristic could better be explained on the basis of

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the tumor growing outward from the bone. Kronfeld[13] suggested that any pathologic overgrowth, corresponding to an early stage of tooth development which normally is in very close connection with the epithelium of the mouth through the medium of the dental lamina, would naturally show a similar connection with the covering epithelium from which the normal tooth germ develops.

Siegmund and Weber[12] believed that the origin of an ameloblastoma could not be definitely established in the absence of an odontogenic cyst. McWhirter and associates[11] pointed out that the occasional tumor that arises directly from cells of the basal layer of the mucous membrane is superficially placed and is sometimes referred to as a superficial adamantinoma but, as a general rule, is called basal-cell carcinoma. Thoma[5] stated that tumors formed from the oral mucosa of the adult were essentially peripheral tumors, although they could encroach upon the bone and cause erosion or infiltration of the jaw.

The two cases in the literature suggesting a peripheral lesion leave much to be desired as far as fulfilling the requirements of a true peripheral ameloblastoma is concerned. The first case was described by Gullifer[14] in 1936 as lesions limited to the soft tissues, occurring in both the left mandible and the left maxilla subsequent to trauma of many years' duration. The lesions extended from the midline to the molar regions. Although there was excess bone contributing to the masses, the excised bone was normal. The subepithelial tissues presented solid structures of imperfectly calcified enamel within epithelial islands. Dentine and cementum were absent. The epithelial proliferation in the submucosa was compatible with the adamantine epithelioma but not typical of the differentiated type of adamantinoma. Neither the peripheral columnar cells with typically placed nuclei nor the loose stellate arrangement of the central cells could be identified. A two-year follow-up of this case revealed no recurrence. In the second case, Ch'in[15] merely mentioned an ameloblastic soft tissue growth without the involvement of the underlying jawbone. No microscopic description or illustrations were included in the article.

CASE REPORT

Clinical History.—A 34-year-old white woman was referred for multiple extractions and removal of a small peripheral growth on the lingual surface of the right mandible between the second premolar and the first molar. The lesion was firm in texture, of normal mucosal color, and presented a sessile base. Ulceration and infection were not evidenced. The mass was asymptomatic but represented a considerable annoyance to the patient. Although several teeth had been extracted previously because of carious involvement, no history of impacted or missing teeth or cyst formations was elicited. Except for some resorption of the interproximal alveolar crests (Fig. 1) above the level of the tumor, roentgenograms revealed the bony architecture to be normal. The lesion, with a rim of normal tissue and periosteum, was removed under general anesthesia. A surgical cement dressing was applied and left for twelve days. Healing was uneventful. The oral surgeon interpreted the lesion to be merely a sessile fibroma.

Pathologic Findings.—The specimen consisted of a semispherical mass of grayish white soft tissue measuring 9 by 7 mm. A glistening white, smooth membrane covered the convex surface. There was no evidence of ulceration.

Microscopically, the specimen presented a submucosal nodule of nests and cords of epithelial tissue resembling the dental lamina. This nodule measured approximately 5 by 4 mm. and was covered by stratified squamous epithelium. The epithelial structures in the nodule formed a plexiform network lying in edematous, loosely arranged, pale-staining

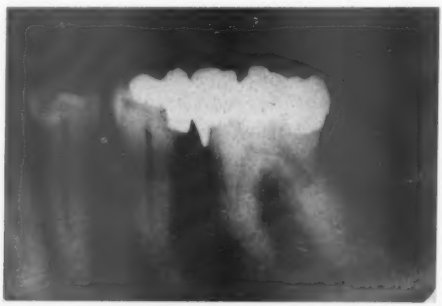

Fig. 1.—Roentgenogram of tumor area. Resorption of alveolar crest between second premolar and first molar is apparent. Bone structure is otherwise normal. (Magnification, ×3.5.)

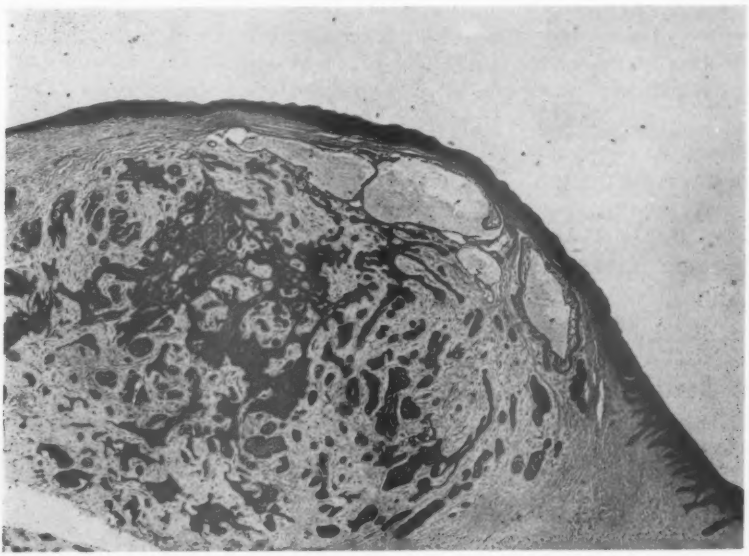

Fig. 2.—Typical ameloblastic structure is seen. The epithelium of the cystic chambers does not quite make contact with the covering atrophic gingival epithelium. (Magnification, ×23.)

collagenous tissue. Occasionally mast cells were seen. Numerous microcysts occurred within the epithelial masses, and several chambers of a multilocular cyst could be observed on the surface of the nodule. Serial sections showed the epithelial component to be always separated from the covering atrophic gingival epithelium by a band of dense collagen (Fig. 2).

The peripheral cell layer of the epithelial nests consisted of closely packed cuboidal to columnar cells arranged in a palisade fashion, perpendicular to the more centrally located

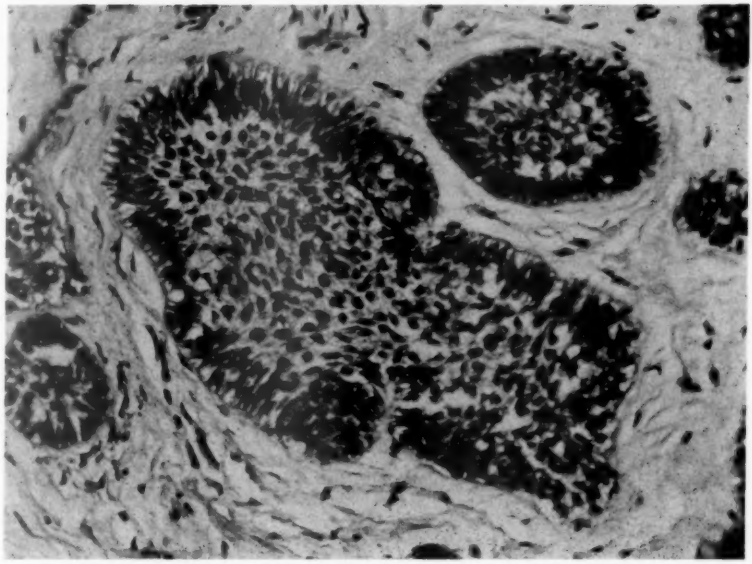

Fig. 3.—The closely packed peripheral cuboidal to columnar cell layer is demonstrated. The centrally located cells lack definite orientation. (Magnification, ×140.)

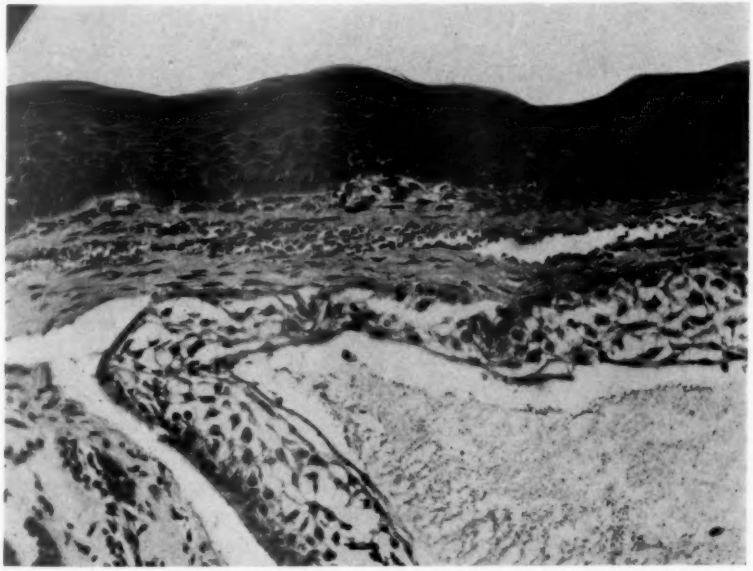

Fig. 4.—The extreme edematous changes of the lining epithelium have produced the characteristic of stellate reticulum. The covering gingival epithelium is devoid of rete pegs. (Magnification, ×103.)

cells which lacked definite orientation (Fig. 3). In the larger nests there had occurred edematous changes which separated the individual cells and accentuated the intercellular bridge formation. Where the edematous changes were extreme in the epithelium, typical stellate reticulum was recognized (Fig. 4). The cystic areas previously described were lined by stellate reticulum and contained cellular debris. No mitotic figures were found. Occasionally hyalinized or keratinized foci were observed within the nests. Each nest presented a prominent basement membrane and a surrounding hyalinized halo (Fig. 5).

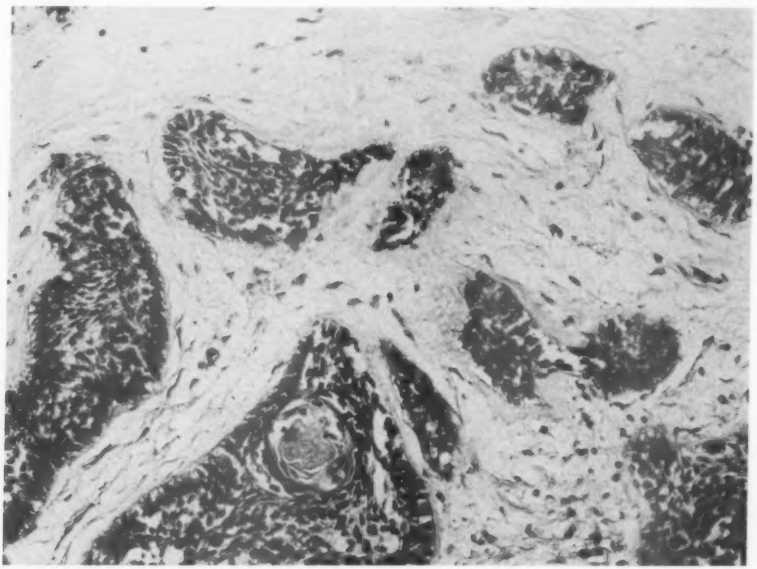

Fig. 5.—A keratinized focus is seen in the largest epithelial nest. The hyalinized halo is manifested by a clear acellular zone about the nests (arrows). (Magnification, ×103.)

A typical chronic inflammatory infiltrate of moderate intensity consisting of plasma cells and lymphocytes was found in the adjacent gingival tissues. The tumor nodule itself was relatively free of inflammatory cells. A bone trabecula was found deep in the tissue, separated from the tumor nodule by a prominent band of collagen.

A diagnosis of peripheral ameloblastoma of the gingiva was made.

COMMENT

This lesion apparently represents an ameloblastoma arising outside the mandibular bone proper, not connected with centrally located odontogenic epithelial remnants or an odontogenic cyst. The exact origin of the growth was not determined. The fact that the epithelium overlying the tumor is thinned out and atrophic without rete pegs detracts from the thought of surface epithelial origin. However, the fact that the oldest portion of the growth, as manifested by cystic degeneration, was closest to the surface epithelium supports the latter location.

SUMMARY

A peripheral ameloblastoma is described. The rarity of this lesion is discussed. The required histopathologic characteristics of such a lesion are fulfilled. The origin of the tumor was not proved, although it most probably arose from odontogenic epithelial cell rests outside the jawbone proper. The minute size of the neoplasm is also of particular interest.

REFERENCES

1. Bernier, Joseph L.: The Management of Oral Disease, St. Louis, 1955, The C. V. Mosby Company, p. 689.
2. Small, I., and Waldron, C.: Ameloblastomas of the Jaws, ORAL SURG., ORAL MED. & ORAL PATH. **8**: 281-297, 1955.
3. Bernier, Joseph L.: The Management of Oral Disease, St. Louis, 1955, The C. V. Mosby Company, p. 527.
4. Robinson, H.: Ameloblastoma—A Survey of 379 Cases, A. M. A. Arch. Path. **23**: 831-843, 1937.
5. Thoma, Kurt H.: Oral Pathology, ed. 4, St. Louis, 1954, The C. V. Mosby Company, pp. 1169-1191.
6. Bakay, L.: Origin of Central Epithelioma of the Mandible, Orvosi hetil. **52**: 473-478, 1908.
7. Kuru, H.: Ueber das Adamantinom, Centralbl. allg. Path. u. path. Anat., Jena **22**: 291-295, 1911.
8. Krompecher, E.: Zur Histogenese und Morphologie der Adamantinome und sonstiger Kiefergeschwülste, Beitr. path. Anat. **64**: 165-197, 1917-1918.
9. Kaufmann, E.: Lehrbuch der speziellen pathologischen Anatomie Für Studierende und Aerzte, vol. 2, Berlin and Leipzig, 1922, W. de Gruyter & Co., p. 999.
10. Fish, E. Wilfred: Surgical Pathology of the Mouth, Philadelphia, 1951, J. B. Lippincott Company, p. 430.
11. McWhirter, R., Fitzgibbon, G., Shanks, W., and Fickling, B.: Symposium of the Treatment of Adamantinoma, Proc. Roy. Soc. Med. **45**: 701-709, 1952.
12. Siegmund, H., and Weber, R.: Pathologische Histologie der Mundhöhle, Leipzig, 1926, S. Hirzel, p. 330.
13. Kronfeld, R.: Adamantinoma, J. Am. Dent. A. **17**: 681-703, 1930.
14. Gullifer, W.: Adamantinoma, Dental Cosmos **78**: 1256-1259, 1936.
15. Ch'in, K.: Adamantinoma in Chinese, Chinese M. J. (supp. II), pp. 91-130, 1938.

ANNOUNCEMENTS

New York Institute of Clinical Oral Pathology, Inc.

A course in clinical oral pathology will be given in sixteen sessions, 7:30 to 10 P.M., two Wednesday evenings monthly from October, 1959, through May, 1960. The class is limited to thirty students.

There will be lectures on embryology, hematology, histology, and pathology and their clinical interpretation. These lectures will be illustrated by lantern slides, microscopic slides, etc. Case reports stressing history, clinical findings, x-ray studies, diagnosis, treatment, and prognosis will be given by the staff of the Institute and by guest lecturers. The course is approved by the Board of Education of the University of the State of New York.

Inquiries should be addressed to the Executive Secretary, 101 East 79th St., New York 21, New York.

American Board of Oral Pathology

The next examination for certification will be held on Dec. 5 and 6, 1959. Applications must be completed by July 1 in order to qualify for the December examination. The place will be announced when the geographical distribution of candidates has been determined.

Application should be made to Dr. Donald A. Kerr, Secretary-Treasurer, The University of Michigan School of Dentistry, Ann Arbor, Michigan.

1959 Mid-Continent Dental Congress

The 1959 Mid-Continent Dental Congress will take place Nov. 1 to 4, 1959, at the Chase-Park Plaza Hotel in St. Louis, Missouri.

The Indianapolis Dental Research Group will offer a four-day postgraduate course. On Sunday, November 1, a four-hour course entitled "An Approach to Patient Management" will be presented through skits, play acting, and audience participation in a complete dental office set up on the stage. This course will cover case presentation, office personnel, financial arrangement, and diagnosis and treatment planning. On Monday, Tuesday, and Wednesday, November 3, 4, and 5, there will be fourteen lectures on restorative dentistry, oral surgery, full and partial dentures, children's dentistry, periodontia, oral diagnosis, esthetics, and full mouth reconstruction.

All members of the American Dental Association are cordially invited to attend this fast-growing Mid-Continent Dental Congress.

Further information may be obtained from the St. Louis Dental Society, 8013 Maryland Ave., St. Louis 5, Missouri.

Temple University

Temple University School of Dentistry announces that a two-week course in advanced orthodontics will begin on Jan. 17, 1960, under the direction of Dr. Robert H. W. Strang.

The course is open to practicing orthodontists only. The cost is $300.00, exclusive of instruments and books.

Those interested may apply to Dr. Louis Herman, Director of Postgraduate Studies, Temple University School of Dentistry, 3223 North Broad St., Philadelphia 40, Pennsylvania.

Third Colombian Congress of Plastic, Maxillo-Facial, and Hand Surgery

The Third Colombian Congress of Plastic, Maxillo-Facial, and Hand Surgery will be held Aug. 7 to 15, 1959, in Cali, Colombia, South America.

Jaime Guzmán Guzmán
Secretary General
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Cali, Colombia

REVIEWS OF THE LITERATURE

ABSTRACTS OF CURRENT LITERATURE

Radiological Identification of Fibrous Dysplasia of the Jaws. R. S. Sherman and O. J. Glauser. Radiology 71: 553, October, 1958.

This study covers seventeen histologically proved cases of fibrous dysplasia of the jaws. There were eleven female patients and six male patients. The lesion was located in the mandible in eleven patients, in the maxilla in five, and in the mandible and maxilla in one. The age range was 8 to 44 years, with nine of the series between 8 and 14 years, four between 17 and 25, and four between 31 and 44.

Three roentgenologic types are recognized: One shows a diffuse, homogeneous sclerosis tending generally to follow the contour of the bone; one shows a multiloculated appearance, lytic in character and oval in shape, with septa or ridges, a relatively sharp border, cortical thinning and expansion, and frequently calcific strands or flecks; a third shows a unilocular pattern.

T. J. C.

Fluothane for Ambulatory Dental Procedures. A Brief Research Report. M. S. Shane. J. Am. D. Soc. Anesth. 5: 5, December, 1958.

Fluothane, a colorless liquid with a pleasant odor, is the most potent of all the inhalation anesthetics. The drug is nonflammable; it exerts a depressant action on the vomiting center and does not affect the liver, kidneys, or other organs pathologically.

Fifty ambulatory patients were given fluothane for dental procedures with nitrous oxide and oxygen with satisfactory results.

Further research will have to be done before a definite opinion as to fluothane's place in ambulatory dental anesthesia can be established.

T. J. C.

Tumors of the Minor Salivary Glands. R. L. Brown, E. L. Bishop, and H. S. Girardeau. Cancer 12: 40, January-February, 1959.

Minor or accessory salivary glands are similar to major salivary glands, except for their size and location. Tumors of minor salivary gland origin may occur in the mucosa of the hard palate, the soft palate, the tongue, the floor of the mouth, and the alveolar ridges. They are slightly more common in women than in men.

Of the thirty-eight patients in this review, fourteen had benign tumors and twenty-four had malignant ones. Thirteen of the benign growths were mixed tumors; one was papillary cystadenoma. Of the twenty-four patients with malignant tumors, three had malignant mixed tumors, five had mucoepidermoid carcinoma, and sixteen had adenocarcinoma.

Surgery is the treatment of chioce. When the adequacy of the excision is questionable, radiation therapy should be given.

T. J. C.

Thirty-ninth and Thirty-eighth Year Follow-up of Mandibular Bone Grafts in Three Cases. R. H. Ivy, and J. D. Eby. Plast. & Reconstruct. Surg. **22:** 548, December, 1958.

Three cases are reported in which the patients are in good health, with satisfactory function and appearance thirty-nine and thirty-eight years after bone graft to the mandible.

The bone was taken from the crest of the ilium.

The authors feel that autogenous bone graft from the crest of the ilium, if it lives, remains as it is and is not absorbed and replaced by new bone.

The cases reported here were treated before sulfonamide drugs or antibiotics became available.

T. J. C.

Head and Neck Pain in Temporomandibular Joint Disease and Muscle Spasm. A. S. Freese. A. M. A. Arch. Otolaryng. **67:** 410, April, 1958.

Mandibular muscle spasm is a factor in pain in the temporomandibular area. Ethyl chloride spray is applied to the area in long, slow, sweeping movements so that the skin is not whitened. This is continued until the pain is relieved. Moist heat is applied two to four times a day for periods from a half-hour up to one hour. Muscle relaxants are useful where the patient cannot use moist heat.

T. J. C.

Dermal Fistulas of Dental Origin in Children. R. W. Olmsted. J. Pediat. **53:** 221, August, 1958.

"A draining fistula in the submandibular area in children presents a difficult diagnostic problem. One causative factor which seems to be relatively unfamiliar to pediatricians is a periapical dental abscess with sinus tract formation which erupts on the skin surface."

The author reports four cases in which the removal of an infected tooth was said to cure subcutaneous abscess.

T. J. C.

Immobilization of Subcondylar Fractures After Open Reductions. M. Robinson. J. South. California D. A. **26:** 330, September, 1958.

Five methods of immobilization of subcondylar fractures after open reduction are used. Open reduction through a preauricular approach in a child, open reduction with intraosseous wiring, bone screws and a new type of steel plate through a Risdon approach are reported.

In intraosseous wiring, No. 20 stainless steel wire is used; the bone screw is No. 316 in stainless steel, and the plate of stainless steel is 1.3 cm. long with screw holes.

The Risdon approach is a submandibular one to expose the ascending ramus and the angle of the mandible.

T. J. C.

Alcoholic Gasserian Injection for Relief of Tic Douloureux. Preliminary Report of a Modification of Penman's Report.* A. Eiker and T. Perl. Neurology **8:** 462, June, 1958.

A needle is inserted into the posterior root of the gasserian ganglion. A preliminary radiographic study determines the entry point of the needle. After the needle is inserted vertically downward, further radiographic study indicates the precise relation of the needle to the base of the skull and permits accurate adjustment of its depth.

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*Penman, J.: The Differential Diagnosis and Treatment of Tic Douloureaux, Postgrad. M. J. **26:** 627, 1950.

Procaine (2 per cent, 0.03 c.c.) is injected to determine the position of the needle within the posterior root; the needle is further adjusted if necessary. The patient's neck is straightened so that he faces the ceiling squarely; then one to six therapeutic injections of 0.05 c.c. of absolute alcohol are made, guided by careful sensory and motor testing.

Forty-five patients have been treated over a period of thirty-six months, with satisfactory results.

T. J. C.